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CONTENTS

FIRST DAY

June 6, 1935

1. Giant Hydronephrosis. CHARLES P. HOWZE..... 1
2. Pararenal Pseudo-Hydronephrosis. E. GRANVILLE CRABTREE..... 9
3. Carbuncle of the Kidney. ROGER C. GRAVES and LEROY E. PARKINS... 41
Discussion
4. Resection of Large Solitary Renal Cysts. VINCENT J. O'CONOR..... 83
5. Actinomycosis of the Kidney in Infancy and Childhood. HERMAN L. KRETSCHMER and WILLIAM G. HIBBS..... 93
Discussion
6. Massive Stone in the Pelvis of a Double Kidney. ROBERT C. BRYAN... 117
7. Transabdominal Extraperitoneal Nephrectomy. N. P. RATHBUN..... 139
8. Spontaneous Dissolution of Renal Calculi. IRA R. SISK and R. C. BUNTS 149
9. Further Observations on the Experimental Production of Urinary Calculi. C. C. HIGGINS..... 157
Discussion
10. Late Effects of Various Types of Trauma to the Kidney. J. A. C. COLSTON and WALTER W. BAKER..... 171
11. An Unusual Anomaly of the Kidney. H. G. HAMER, H. O. MERTZ and FRANK FORREY 193

SECOND DAY

June 7, 1935

12. Carcinoma of the Colon Involving the Bladder. FLETCHER H. COLBY... 199
13. Cyst of the Bladder. GEORGE R. LIVERMORE..... 209
14. Rupture of the Urinary Bladder Associated with Prostatic Hypertrophy. A. J. SCHOLL..... 217
Discussion
15. The Rôle of Congenital Anomalies in the Production of Urologic Conditions in Children, with Special Mention of Congenital Idiopathic Dilatation of the Ureter. GILBERT J. THOMAS and JOHN C. BARTON.. 231
16. Anomalous Relationship of the Right Ureter to the Vena Cava. ALEXANDER RANDALL and EDWARD W. CAMPBELL..... 239
Discussion
17. Roentgentherapy for Recurring Bladder Tumors of Low Malignancy. EDWARD L. KEYES, RUSSELL S. FERGUSON and ALFRED F. HOCKER..... 265
Discussion

18. Schistosomiasis Involvement of the Upper Urinary Tract. A. R. Stevens 275
Discussion
19. Obstructions at the Bladder Neck in Infants and Children. John R. Caulk 287
20. The Presentation of a New Cautery Punch. John R. Caulk..... 297
Discussion

THIRD DAY

June 8, 1935

21. Cyst of the Seminal Vesicle. Clyde LeRoy Deming..... 301
22. Diverticulum of the Prostatic Urethra with Stone. J. Bayard Clark... 313
23. Recent Work on the Prevalence of Carcinoma of the Prostate. Hugh H. Young 317
Discussion
24. Bilateral Malignant Lesions of the Upper Urinary Tract. Howard S. Jeck 337
25. The Lymphatics of the Lower Urinary and Genital Tracts. David W. MacKenzie and Alexander B. Wallace..... 345
26. A Consideration of Testicular Prosthesis. J. Dellinger Barney..... 369
Discussion
27. Some Observations on Female Urology. William E. Stevens..... 377
Discussion
28. Intrathecal Injections of Absolute Alcohol for the Relief of Intractable Pain. Charles M. McKenna and Eric Oldberg..... 391
Discussion
29. A Further Report on the Cure of Hypospadias and Epispadias. Arthur B. Cecil 399
Discussion
30. Kaposi's Disease of the Penis. Benjamin S. Barringer and Archie L. Dean, Jr..... 409
Discussion
31. Congenital Canals and Cysts of the Genito-perineal Raphe. John H. Neff 415

THE AMERICAN ASSOCIATION OF GENITO-URINARY SURGEONS

FIRST DAY, JUNE 6, 1935

GIANT HYDRONEPHROSIS

REPORT OF A CASE

CHARLES P. HOWZE, M.D.
Washington, D. C.

I have recently encountered an unusually massive hydronephrosis, the pyelographic study of which seems to be of sufficient interest to warrant a report. A study of the literature shows that such giant tumors are of infrequent occurrence. A review of the cases reported during the past twenty-five years reveals only thirty-two to which that ambiguous term may be applied. This group of cases shows a wide latitude in size, ranging from a hydronephrosis of 900 c.c. capacity in an infant, to a tumor from which 50 liters of urine were removed by abdominal paracentesis. Doubtless there have been other similar cases which have not been reported. Twelve (31 per cent) of these large abdominal tumors received cystoscopic examination. Two pyelograms were reported. The scarcity of pyelographic study is no doubt due to the fact that it was rightly considered unwise to inject these large retentive sacs with our former media. Since the advent of the non-irritative organic iodide preparations for intravenous and retrograde use, the objections to making pyelograms has to a large extent been removed. In thirty of the reported cases, the patients were operated upon; one died following repeated abdominal paracentesis, and the diagnosis in another was made at autopsy. There were eleven transperitoneal nephrectomies, while in six instances the operative approach was not mentioned. The eleven abdominal incisions corresponded in number to the erroneous pre-operative diagnoses. The diagnoses in these cases were as follows: ovarian cyst 7; hydatid cyst of the liver 1; retroperitoneal cyst 1; renal tumor 1; tuberculous peritonitis 1.

I wish to add an additional case, in which the diagnosis was made through cystoscopic study and pyelography. The interesting features presented by this patient are: (1) The enormous size the pelvis had reached; (2) the relatively few symptoms suffered over

a long period of time; (3) that a hydronephrosis of such caliber could have continued to function one-third of that of a normal kidney, as was shown by the urine specific gravity and urea estimation; and (4) that a satisfactory pyelographic study was obtained with a small quantity of opaque medium.

CASE REPORT

Mrs. J. R., female, aged fifty-eight, was first seen on March 18, 1931. At that time, the only complaint was a dull pain in the left lumbar region, accompanied by a sense of fullness in the abdomen. The pain had been present for two days. In 1904, during the sixth month of her only pregnancy, a large cystic swelling appeared in the left flank, followed by hematuria. The hematuria ceased after a few days, but the tumor persisted. It caused no discomfort, and did not in any way interfere with the normal course of gestation and delivery. While conscious of a mass in the left lumbar region, no further symptoms were noted until 1906, when there was some increase in the size of the abdomen, accompanied by pain. A note from Dr. G. Brown Miller reporting his examination at this time states, "I obtained by ureteral catheter, on two separate days, 30 and 34 ounces of urine from the left kidney. An examination of the separated kidney urines showed the left kidney crippled, but not functionless. The specific gravity of the right kidney urine was 1.015, while that of the left was 1.006. The urea output was 15.5 mgm. per 100 c.c. from the right kidney, 10 mgm. per 100 c.c. from the left. "There was no further abdominal complaint until March 16, 1931, a period of twenty-five years. The only symptoms noted were infrequent attacks of dizziness, palpitation, and aching pain in both arms extending to the elbows, following exertion."

General physical examination gave negative findings, except for a large cystic tumor filling the left half of the abdomen, and extending to the midline (Fig. 1). The mass was definitely fluctuant and slightly tender. The blood pressure was: systolic 156, diastolic 100. Temperature was 98. Blood analyses were normal. The catheterized urine contained a trace of albumin and 20 to 30 pus cells to a microscopic field.

On cystoscopic examination, the bladder was found normal. There was no obstruction to the passage of catheters to either kidney. The urine from the right kidney was normal. The left contained 15 to 20 pus cells to a microscopic field. "Phthalein" appeared in two minutes from the right kidney with a total excretion of the dye of 20 per cent in fifteen minutes. There was no trace of the dye from the left. Five hundred cubic centimeters of urine was aspirated through the left catheter. An x-ray with the opaque catheter *in situ* revealed the left ureter deviated to the right, and entering the renal pelvis at a right angle at the upper margin of the fourth lumbar vertebra. The outline of the right kidney appeared normal.

A diagnosis of left hydronephrosis was made and nephrectomy advised. The patient was entirely relieved of symptoms following partial kidney drainage, and declined operative intervention. Subsequently, in April, 1934, she had a mild but definite coronary occlusion, which cleared up following three weeks' rest in bed. There were no further

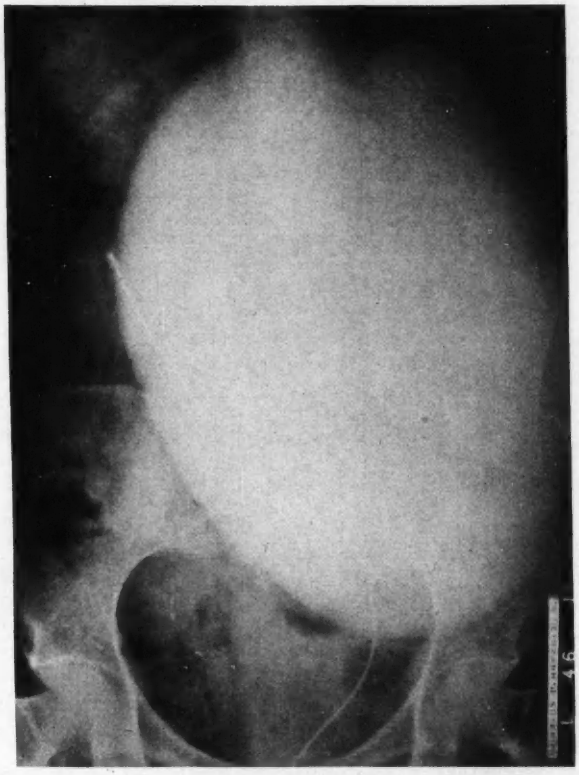

Fig. 1. Pyelogram of giant hydronephrosis (left).

symptoms referable to the kidney until February 16, 1935, at which time pain became acute in the left half of the abdomen. Five hundred cubic centimeters of urine were drained from the hydronephrotic sac on this date. Pain was only partially relieved. Four days later 1,200 centimeters were removed through a number 8F. catheter, which passed readily. Following the removal of 1,000 c.c. of fluid, 50 c.c. of

CASES REPORTED IN LITERATURE (1910-1935)

Author	Sex	Age	Diagnosis	Pre-operative treatment	Urological study	Surgical incision	Operative findings
1. Heitz-Boyer (1910)	M	22	Hydatid cyst of the liver		None	Abdominal	2000 c.c. hydronephrosis complicated by tuberculosis
2. Viannay (1910)	F	68	Left hydronephrosis with possible neoplasm		Cystoscopy	Not stated	Enormous hydronephrosis with kinking of ureter
3. Whitacre (1911)	F	68	Ovarian cyst		None	Abdominal	8 liter hydronephrosis
4. Eisendrath, D. N. (1911)	M	12	Left hydronephrosis		Cystoscopy	Not stated	2 quart hydronephrosis with congenital stricture of the ureter
5. Mosny, Javal and Dumont (1913)	F	25	Peritoneal tuberculosis	Paracentesis of abdomen on four occasions	None	None	Patient died two weeks following paracentesis; 15 liters removed by paracentesis
6. Young, J. V. (1913)	F	38	Ovarian cyst		None	Abdominal	8 liter hydronephrosis
7. Kakels (1916)	Infant	6 mos.	Hydronephrosis (congenital)		None	Abdominal	900 c.c. hydronephrosis
8. O'Neil, R. F. (1920)	M	38	Left hydronephrosis		Cystoscopy	Not stated	5 quart hydronephrosis with a dilated ureter
9. Viannay and Cadéac (1921)	F	29	Hydronephrosis		Cystoscopy	Not stated	Large hydronephrosis
10. Hirst, B. C. (1923)	F	25	Ovarian cyst		None	Abdominal	Enormous hydronephrosis
11. Viannay (1924)	M	34	Hydronephrosis		Cystoscopy	Not stated	5 liter hydronephrosis
12. Sprague, E. W. (1926)	M	10	Retroperitoneal cyst		None	Abdominal	Low ureteral stricture with cyst of the ureter; large hydronephrosis, chronic nephritis
13. Ducrey (1926)	F	16	Ovarian cyst		None	Abdominal	10 liter hydronephrosis due to stricture of ureter
14. Wybert (1926)	F	30	Ovarian cyst		None	Anterior colpotomy; abdominal	6 liter hydronephrosis
15. Claus, W. (1926)	F	50	Hydronephrosis	Paracentesis 33 liters; two years later 50 liters	None	Not stated	Large hydronephrosis
16. Claus, W. (1926)	F	60	Hydronephrosis	Nephropexy	None	Not stated	10.5 liter hydronephrosis

15. Claus, W. (1926)	F	50	Hydronephrosis	Paracentesis 33 liters; two years later 50 liters	None	Not stated	Large hydronephrosis
16. Claus, W. (1926)	F	60	Hydronephrosis	Nephropexy 20 years before	None	Not stated	10.5 liter hydronephrosis
17. Claus, W. (1926)	M	19	Hydronephrosis		None	Not stated	Enormous hydronephrosis; cyst sutured to abdominal wall
18. Schultz (1928)	F	32	Hydronephrosis and pregnancy		None	Abdominal	27 x 40 cm. hydronephrosis; weight 2460 gm.
19. Schultz (1928)	F	43	Pyonephrosis		None	Abdominal	24 x 70 cm. hydronephrosis; weight 5125 gm.
20. Milligan, E. T. C. (1929 30)	F	70	(1) Ovarian cyst (2) Hydronephrosis		Cystoscopy	Not stated	Hydronephrosis 26 x 26 x 12; tumor crossed midline
21. Huggins, C. B. (1930)	M	76	Hydronephrosis		Cystoscopy	Loin	Large hydronephrosis crossing midline
22. Huggins, C. B. (1930)	M	35	Hydronephrosis		Cystoscopy and pyelogram	Loin	Large hydronephrosis extending from diaphragm to pelvis and across the midline
23. Kuestner (1931)	F	31	Hydronephrosis		None	Abdominal	20 pound hydronephrosis
24. Chiofalo, I. (1932)	M	50			None		29 x 18 cm. hydronephrosis found at autopsy
25. Astraldi, A., and Martínez, F. (1932)	M	59	Hydronephrosis		Cystoscopy	Not stated	6 liter hydronephrosis
26. Toptchan (1932)	M		Not stated	Paracentesis 9 liters	None	Not stated	Autopsy; large hydronephrosis
27. Toptchan (1932)	F	7	Not stated	Paracentesis 3 liters	None	Not stated	Hydronephrosis
28. Toptchan (1932)	M	30	Not stated		None	Not stated	4000 c.c. hydronephrosis
29. Toptchan (1932)	M	18	Not stated		None	Not stated	35 x 8 cm. hydronephrosis
30. Lucena (1933)	M	31	Not stated		None	Abdominal	24 x 10 x 13 cm. hydronephrotic sac of 4 liters' capacity
31. Gasparian, A. N. (1933)	F	58	Hydronephrosis		Cystoscopy and pyelogram	Not stated	Hydronephrosis 29 x 12 cm., weighing 2400 gm. (without the fluid)
32. Winsbury-White (1935)	M	41	Hydronephrosis		Cystoscopy	Not stated	Large hydronephrosis extending across midline

skiodan was injected. X-ray revealed an enormous hydronephrosis extending from the diaphragm to the pelvis, crossing the midline and overshadowing a large portion of the right kidney outline. An analysis of the urine removed was of considerable interest, in that the specific gravity measured 1.014, and the urea content 6.69 mgm. per 100 c.c. The patient continued to have some slight discomfort, and on February 23, 1935, 2,300 c.c. of fluid was removed. Complete relief of abdominal symptoms followed until the time of the patient's sudden death from cerebral thrombosis four weeks later. Unfortunately, a postmortem examination could not be obtained, hence the etiology and true fluid capacity of the sac remain undetermined.

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BIBLIOGRAPHY

1. Astraldi, A., and Martínez, F.: Hidronefrosis gigante, infectada, a desarrollo tóraco-abdómino-pelviano; nefrectomía; curación. Semana méd., Buenos Aires, 39(2): 1094-1097, 1932.
2. Chiofalo, I.: Su tre casi di idronefrosi unilaterale. Arch. ital. anat. pat., Milano, 3:718-724, 1932.
3. Claus, W.: Zur Pathologie und operativen Behandlung grosser Hydronephrosen. Dissertation. Berlin, E. Ebering, 1926.
4. Ducrey, E.: Un cas d'hydronéphrose monstre (10 litres) chez une jeune fille de 16 ans. Schweiz. med. Wchnschr., Basel, 56:445, 1926.
5. Eisendrath, D. N.: Two cases of congenital hydronephrosis. Jour. Am. Med. Assn., Chicago, 57:110-111, 1911.
6. Gasparian, A. N.: Gigantic hydronephrosis. (Russian.) Soviet. khir., Mosk., 5:97-99, 1933.
7. Heitz-Boyer, M.: Coexistence d'une hydronéphrose volumineuse et de lésions tuberculeuses. Ass. soc. franç. d'urol., Proc. verb., Par., 13:546-550, 1910.
8. Hirst, B. C.: Unusual hydronephrosis with a pyelogram of the other kidney. Am. Jour. Obst. and Gynec., St. Louis, 6:233, 1923.
9. Huggins, C. B.: Hydronephrosis (four cases). Surg. Clin. No. Am., Phila. & Lond., 10:383-398, 1930.
10. Kakels, M. S.: Large congenital hydronephrosis in an infant six weeks of age. N. York Med. Jour., 103:547-549, 1916.
11. Kuestner, H.: Schnelle Entwicklung einer Riesenhydronephrose im 5. Monat der Schwangerschaft mit Ileus. Monatschr. f. Geburtsh. u. Gynaek., Berl., 89:179-184, 1931.
12. Lucena: Megalo-bolsa hidronefrósica. Medicina, Mex., 13:139-141, 1933.
13. Milligan, E. T. C.: Specimen of large hydronephrosis. Proc. Roy. Soc. Med., Lond., 23: Sect. Urol., 10-11, 1929-30.
14. Mosny, Javal and Dumont: Hydronéphrose de 30 litres diagnostiquée tardivement par l'examen physico-chimique du liquide. J. d'urol. méd. et chir., Par., 3:9-24, 1913.
15. O'Neil, R. F.: A case of large hydronephrosis. Internat. Jour. Surg., N. Y., 33:84, 1920.
16. Schultz, M.: Two cases of gigantic hydronephrosis. (Russian.) Vrach. Gaz., Leningr., 32:202-204, 1928.
17. Sprague, E. W.: Congenital obstruction of the ureter resulting in an enormous hydro-ureter and hydronephrosis. Surg. Clin. No. Am., Phila. & Lond., 6:1497-1501, 1926.
18. Toptchan, A. B.: Cases of gigantic hydronephrosis. (Russian.) Urologiya, Mosk., 10:13-17, 1932.

19. VIANNAY: Volumineuse hydronéphrose: néphrectomie après cathétérisme uretéral. Loire méd., 29:9-13, 1910.
20. VIANNAY: Un cas de néphrectomie pour volumineuse hydronéphrose. Loire méd., 38:482, 1924.
21. VIANNAY and CADÉAC: Un cas de néphrectomie pour volumineuse hydronéphrose. Loire méd., 35:137-140, 1921.
22. WHITACRE, H. J.: Huge hydronephrosis (two gallons capacity). Jour. Am. M. Assn., Chicago, 56:1883, 1911.
23. WINSBURY-WHITE, H. P.: Large hydronephrosis removed from a man aged forty-one. West Lond. Med. Jour., 40:6, 1935.
24. WYBERT, A.: Sobre un caso de hidronefrosis gigante. Prensa méd. argentina, Buenos Aires, 13:706-708, 1926.
25. YOUNG, J. V.: Hydronephrosis containing eight quarts of fluid. Am. Jour. Obst., N. Y., 67:1192-1194, 1913.

PARARENAL PSEUDO-HYDRONEPHROSIS

WITH REPORT OF THREE CASES

E. GRANVILLE CRABTREE, M.D.
Boston, Massachusetts

Among the renal diseases is one which, because of lack of knowledge concerning it, because of the rarity of occurrence, and because of the confusing sequence of developments which occur during the weeks or months following its onset, is not often managed to the best advantage to the patient in whom it occurs. It is with the aim of remedying this situation, as far as it is possible at this time, that I herewith present the proved cases from the world's literature, together with the collected clinical observations on these cases and the research work through animal experimentation pertaining to the subject. Aside from Le Dentu and myself, not more than one instance of this condition has been recorded by any one surgeon. It can be said without criticism of the surgeon in whose hands the patient found himself, and certainly equally well of me, that a better knowledge of the condition would have brought the patient to remedial measures at an earlier date when conservative surgery was possible for the preservation of the kidney.

Both from the clinical picture and the pathology produced, pararenal pseudo-hydronephrosis deserves to be recognized as an entity among traumatic lesions of the kidney. As will be shown later in this communication, the nature of the original injury is often not recognized and the patient either is not sent to hospital, or if the original injury required hospitalization the patient was sent out only to return much later with an extensive destructive process far advanced. Both experimental animal work and clinical and pathological studies show that persistence of this condition over a period of months can be expected to destroy the kidney.

Clinically, these patients all had certain findings in common. By the time they reached surgery they presented evidence of a large tumor mass, which often extended from the diaphragm well into the true pelvis and towards, and even well across, the midline of the abdomen. There was a corresponding protuber-

ance of the abdomen on the affected side. The mass was but slightly tender if at all, sometimes fluctuant or fixed. There was little, if any, temperature, but the patient was uncomfortable, in some pain and evidently sick. There was no blood in the urine. Sometimes the urine was entirely negative, showing no albumin, abnormal cells or bacteria. Where cystoscopic studies were done in more recent cases, there was, without exception, no excretion of urine on the affected side, although, in some, patency of the ureter was demonstrated by ureterogram. In one other case (Le Dentu, Case 11) the ureter was noted as "compressed" at the time of operation. This patient did not have a cystoscopic examination previous to operation.

The history, with but two exceptions (Block's and Bianchetti's cases), was of a remote injury at which time there were the usual signs and symptoms of renal damage, usually with hematuria for a short time only, or only microscopic (Morris's case), or none at all (Vincent, Kaiser, Bennoit and Douillet). Stirling's case showed hematuria for a day on the twenty-fifth or twenty-sixth day following injury. Often the patient's condition improved sufficiently so that he was sent home from hospital (Damm, Stirling and Crabtree, Case 22) but never was well enough to be ambulatory. If at home since the injury, he remained in bed. Fair improvement after the injury was the rule.

At some remote date the patient's symptoms changed either gradually or abruptly, but usually the latter. The onset of increased pain, nausea and vomiting marked this period. This was accompanied either by the appearance of a renal tumor where none had been noted before or an increase in size of the tumor already present. In one case (Nové Jusserand), the tumor and also the symptoms subsided two days afterward, to reappear fifteen days later. In another case (Crabtree, Case 23), the tumor appeared fourteen days after injury and remained stationary until it took on rapid growth during the forty-seventh, forty-eighth and forty-ninth days after injury, accompanied by violent symptoms and serious impairment of condition of the patient.

Cystoscopies have demonstrated, in all cases where done, absence of excretion on the affected side. In some, the ureter has been obstructed to the passage of a catheter through its upper third and in one case in its lower three inches. In one case (Crabtree, Case

22) the ureter was catheterizable to the pelvis, but no excretion of urine was obtained although injection medium was shown to pass to the pelvis. Usually there is hydronephrosis although Barker's case showed no hydronephrosis at autopsy and Crabtree's case (Case 22) showed none by pyelogram.

The renal pelvis is displaced in relation to the spine, more often occupying the upper and outer portion of the tumor shadow.

The ureter is displaced in its mid third towards the midline and becomes lost in the tumor mass. In Case 22, it crossed the tumor mass obliquely and filled poorly in its mid portion. The ureter was proved by operation to lie midway in the thickness of the walls of the sac and to be surrounded by dense, fibrous tissue. In Case 21, the pelvis could not be filled by injecting the ureter.

On surgical approach there is little evidence of the normal, perirenal adipose tissue. In its place is a dense, reddish colored, fibrous mass, over the surface of which are engorged veins. The mass is fixed in the renal gutter. It is vaguely fluctuant.

If approached transperitoneally (Crabtree, Case 22) the mass can be seen to cross the spine *beneath* the great vessels and in this case dissected beneath the common iliac vessels to enter deep into the true pelvis. This is similarly described by Picard. The mass extended well above the normal renal position to be moulded by the dome of the diaphragm and laterally by the thoracic wall and abdominal muscles.

When opened there is a definite fibrous wall containing urine in almost unbelievable quantity. There is usually found debris consisting of fibrous material, fatty, oily debris and changed blood clot; occasionally there are deposits of urinary salts. In one case where a fragment of kidney had become deached the fragment was supplied by an artery and vein and was viable (Damm). In another (Crabtree, Case 21) three fragments were implanted without blood supply into the wall of the sac some distance from the kidney, where they were leading an anemic, separate existence but were still viable. In still another case (Picard's) the fragments of the kidney were found 28 cm. apart.

The kidney occupies a position within the sac similar to that of the testicle within a hydrocele sac. In Kaiser's case, the kidney projected completely into the sac and only its pedicle was involved

in the sac wall. This kidney presumably had a mesenteric envelopment previous to injury.

The readiness with which such kidneys may be removed depends upon the age of the lesion with emphasis placed upon the dense scar tissue of the older lesions and the degree to which the kidney is enveloped by the sac wall.

It is only in the more simple forms of injury (Sterling's case) or in those recognized early (Bianchetti's case) that conservative surgery can be employed successfully. In most cases operated remotely, only renal destruction produced cure. Either primary or secondary nephrectomy was employed for cure in eight cases and subterfuges for destruction of the kidney provided cure in two others. Five of the first cases reported (1834-1885, Hawkins, Vincent, Holmes, Barth and Barker) resulted in death. In four incised and drained or puncture drained cases the patients remained uncured. In one case either renal damage produced by the injury and the subsequent fibrosis or more likely fibrosis about the renal pedicle resulted in spontaneous closure of the sinus without the necessity of performing nephrectomy over one year following drainage (Crabtree, Case 22). In still another case (Nisio) the surgeon succeeded in getting closure of the sinus and return of flow down the ureter, but development of hydronephrosis forced him to a later decision in favor of nephrectomy. Scarring about the ureter was the cause assigned for development of the hydronephrosis. In Sterling's case, repair of the injury with drainage produced closure of the sinus, but the patient was followed only for the thirteen days of his hospital stay. Such closure was possible in Nisio's case cited above.

While the condition may arise through spontaneous perforation of a kidney or its pelvis, or rupture of a probably already pathologic kidney such as hydronephrosis from slight cause, the etiologic factor is almost entirely trauma. Trauma, to a perfectly normal kidney, is capable of resulting in a sequence of characteristic developments which immediately, or at a remote period, produce pararenal pseudo-hydronephrosis. That the condition does not occur more frequently implies that the chain of causative factors is seldom complete.

The first of these factors is the type of injury. In the reported cases simple laceration of the cortex extending into a calix (Stir-

ling), fragmentation of the kidney with separation of the fragments from the remainder of the kidney with opening into calices (Damm, Crabtree, Case 22), and fragmentation of the cortex with tears extending into the pelvis (Bianchetti, Mudd, Barth and Crabtree, Case 23) are variations in the possible transcapsular ruptures of the renal parenchyma. Rupture or perforation of the pelvis alone will also produce the condition (Hawkins, Vincent, Holmes and Nisio's cases). In Block's case the condition accompanied a spontaneous perforation of the pelvis by a pelvic calculus.

Tears, or necrosis of the ureter, near to the kidney and within the adipose envelope, occurred to produce the condition in four instances (Bennoit and Douillet, Kaiser, Barker and Chaput).

A second factor in the production of pseudo-hydronephrosis is failure of the original injury to heal before leakage of urine takes place. When we consider the frequency of renal injury, one marvels that some form of urinary leakage is not the rule. Osgood and Campbell note that in fifty-two renal injuries the commonest injury (twenty-eight) was simple contusion. Laceration of the kidney was next highest with eighteen cases, almost one in three in frequency of occurrence. It seems reasonable to suppose that, where simple fracture of the kidney had occurred in these cases of pararenal pseudo-hydronephrosis, and adequate time for healing had elapsed before appearance of the tumor, healing had not occurred either because of separation of the fragments by blood clot or from other means holding the fragments apart or because of complete detachment of the fragment.

The third, and I think the most important, factor in producing the disease, is ureteral obstruction. Such obstruction may already be present (probably was already present in Block's case) or may be acquired through constricting of the ureter by tissue reaction and scarification attendant upon the injury or upon the presence of blood clot near the ureter. Such acquired obstruction from fibrosis will naturally be slow in forming.

In support of this view is Delbet's failure to produce the condition through pinching the kidney of the rabbit through the fatty capsule, to produce renal damage, and the readiness with which Razzaboni produced the lesion by severing the ureter and thereby producing partial obstruction. In addition, Le Dentu found the ureter compressed in the sac wall in his second case. Furthermore,

in *all* the cases in which cystoscopy was done, no urine was excreted through the ureter even though in two cases it was demonstrated to be patent; and finally I submit Figure 1, which is a section of the ureter from Case 22 shown bound down by scar tissue as it lies embedded in the newly formed sac wall. The necessarily slow development of scar tissue well explains the delayed formation of the tumor mass as well as explaining failure

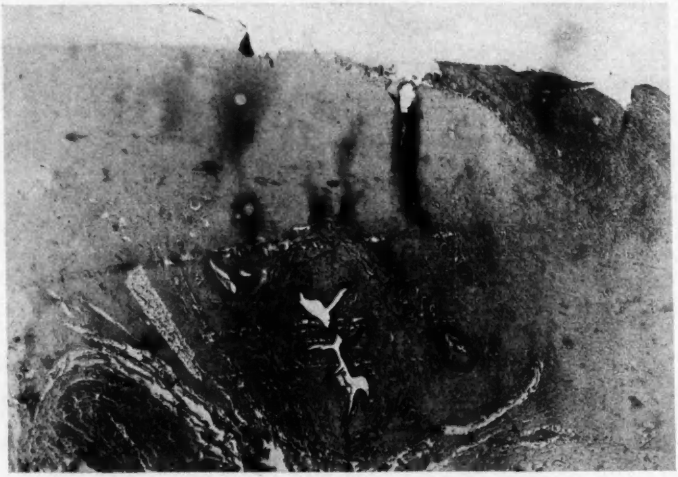

Fig. 1, Case 22. Ureter imbedded in wall of cysts showing fibrosis and distortion of wall of ureter with separation of the muscle fibers.

of the sinus to heal in those patients treated by drainage only without attempting to destroy the kidney.

Hydronephrosis formation in the injured kidney is the rule in these cases. There are two exceptions in this series (Barker and Crabtree, Case 22). In the former case the ureter was extensively torn, in the second case the calix was widely open so that it is unlikely that much fluid could be retained within the pelvis and sufficient intrarenal pressure to produce renal dilatation was, therefore, absent.

The contents of the sac show considerable variation in the cases reported. The presence of urine has been satisfactorily proved in the twenty-three cases here reported. In review of the

literature a certain number of cases were rejected because either urine had not been proved to be present in the contents of the sac or direct communication between the sac and the interior of the kidney had not been definitely established.

According to the report of the operators, nine cases showed clear urine from the sac; five showed cloudy, pus-laden urine; three showed blood and pus-laden urine; three showed dark, hemorrhagic urine; one showed slightly hemic urine; one showed new blood clot and urine (evidently the patient bled fatally into the cavity), and one showed urine, bloody feces and pus (colon injury). In Case 23, the pus-laden urine was sterile in culture.

In addition, various operators have mentioned amorphous fatty debris, necrotic blood clot, necrotic fragments of kidney tissue, fibrinous deposits on the walls and calcification from urinary salts, on the walls of the sac even though the urine was comparatively clear.

PATHOLOGY

For a proper conception of the pathologic changes produced in this disease one must consider the sac wall on the one hand and the renal tissue on the other. The renal tissue is not all the same, since in some instances there was a major fragment which retained its blood supply and in addition, those fragments which were either completely detached from the main fragment or partially separated so that they carried with them sufficient blood supply to insure their viability. Consideration of the viability of this separated tissue is important where conservative surgery is to be considered.

THE SAC WALL

All operators agree that there is little trace of the normal perirenal adipose tissue to be noted on exposure of these kidneys. The pathologist likewise finds little evidence of fat cells in the cyst wall. In most instances little attention has been paid by the operator to the sac wall and specimens for study have not been obtained. Such specimens were obtained in all three of my cases. The age of the lesions in these three cases is forty-nine days (Case 23), two months (Case 21), and seven months (Case 22). In no instance was there any epithelial lining to the sac interior, although the appearance was that of a shiny membrane over which were patchy areas of adherent debris. This finding is in accord

TABLE I. TWENTY-THRE CASES

No.		Age (Yrs.)	Sex	Type of Injury	Duration of Hematuria	Date of Appearance of Tumor after Injury	Subsequent Growth	Cystoscopic Findings on Affected Side	Radi
1	Hawkins 1834*	6	M	Run over	?	10 days	0	Not done	
2	Vincent 1844*	?	F	Thrown to ground	0	Several days	0	Not done	
3	Holmes 1861*	37	F	Horse kick	Present	Present at 24 months	0	Not done	
4	Barth 1876*	70	F	Fall	Present	9 days	0	Not done	
5	Cabot 1883*	10	M	Fall	3 days	Several weeks	0	Not done	
6	Barker 1885*	3½	M	Run over by wagon wheel	1 day	2 months	0	Not done	
7	Morris 1894*	30	M	Run over by wagon	Mic.	6 days	0	Not done	
8	Mudd 1899*	5	?	Run over	4 days	16 days	0	Not done	
9	Chaput 1899*	16	M	Horse kick	?	10 days	0	Not done	
10	Le Dentu 1900*	23	M	Wagon wheel	?	3 days	0	Not done	
11	Le Dentu 1900*	30	F	Fall	?	16 days	0	Not done	
12	Nové-Josserand 1900*	8½	F	?	Present	2 days subsided	15 days later	Not done	
13	Picard 1921	6	?	Run over by wagon	2 days	32 days	0	Not done	
14	Kaiser 1921	24	M	Wagon	0	12 days	0	No urine excreted	
15	Bianchetti 1927	16	F	Fall (Epilepsy)	Present	Immediately	0	Not done	
16	Nisio 1928	12	F	Fall on street	1 day	5 days	Gradual growth 2 months	Non-catheterizable Ureter displaced	Hydr
17	Damm 1932	34	M	Fall	10 days +	After 10th day	Gradual growth 2 months	Non-catheterizable No urine flow	Oval jecti
18	Block 1932	52	M	Colic	Mic.	Immediately	Rapid growth	Stone in pelvis No urine flow	
19	Bennoit & Douillet 1933	44	F	Automobile accident	0	2 months	0	At five months obstruct at 20 cm. No urine flow	
20	Stirling 1934	28	M	Automobile accident	21st day only	26 days	Preceded by hematuria one day gradual after appearance	(Intravenous)	Some Leak Uret
21	Crabtree 1935	5	M	Automobile accident	?	Under 14 days	0	Catheterizable. No uri flow. Ureter displaced	Pelv displ
22	Crabtree 1935	13	F	Automobile accident	Few days	4 months	Rapid during 4-7 month after injury	Catheterizable. No uri flow. Ureter crossed tum	No Disp Uret
23	Crabtree 1935	8	F	Fall over pail	2-3 days	14 days	Rapid 47-48 and 49th days	Obstructed mid-ureter. N urine flow	Hyd Disp

*Collected by Delbet

CASES REPORTED, 1834-1935

Radiographic Findings	Type of Renal Damage	Conservative Treatment	Nephrectomy	Autopsy	End-result
0	2 small holes in pelvis			Autopsy	
0	Torn pelvis			Autopsy	
0	Torn pelvis			Autopsy	
0	Double fracture of upper and lower poles into pelvis			Autopsy	
0	?	Repeated puncture			Uncured
0	Ureter torn			Autopsy (no hydronephrosis at autopsy)	
0	?	Drained			Uncured
0	Kidney ruptured into pelvis	Drained			Uncured
0	Torn colon—torn ureter	Drained	Nephrectomy later		Cured
0	?	Incised and drained			Fistula (uncured)
0	Kidney not seen. Ureter compressed in sac wall	Drained (38th day)	Nephrectomy 5 months later		Cured
0	?	Drained			?
0	Kidney torn in two at lower third		Nephrectomy		Cured
0	Necrotic torn ureter 3 cm. below pelvis		Nephrectomy		Cured
0	Upper pole detached and pelvis split	Injury repaired			Cured
Hydronephrosis	Lacerated pelvis	Drained—unable to remove kidney	Nephrectomy later		Cured
Oval cyst in flank (Air injection)	Lower pole torn off Lower calyx opened		Nephrectomy		Cured
0	Calculus spontaneously perforating pelvis	Paracentesis Catheter drain	Nephrectomy 27 days later		Cured
0	Total shearing off of ureter at pelvis		Nephrectomy		Cured
Some dilatation of pelvis. Leakage into lower pole. Ureter not mentioned	Tear in lower pole	Drained			Cured (13 day result)
Pelvis not filled. Ureter displaced	Damage to lower pole Fragments separated from kidney		(1) Excision part of sac. (2) Pedicle ligated—partial nephrectomy		Cured
No hydronephrosis Displaced pelvis Ureter crossed tumor	Separation of lower pole of kidney opening to calyx	Incision with drainage —unable to remove kidney			Cured by spontaneous autonephrectomy 1 year 2 months
Hydronephrosis Displaced ureter	Complete separation of lower pole opening into pelvis	Drainage, clamp to pedicle			Cured

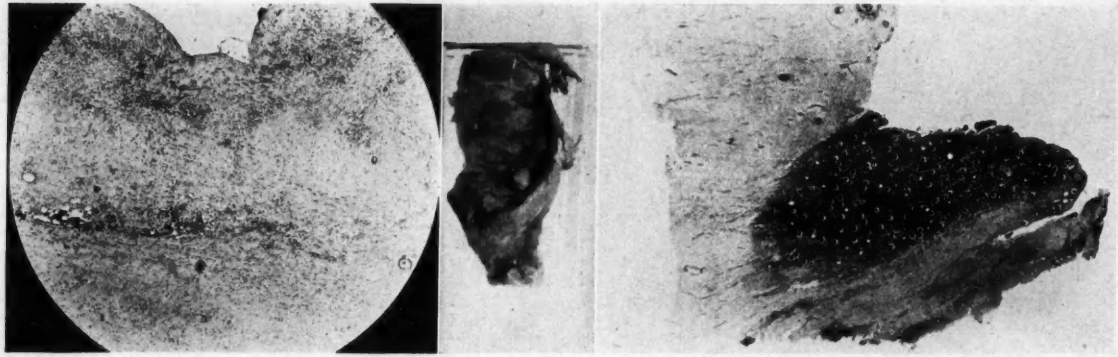

Fig. 2 *(left)*, Case 21. Portion of the sac wall, showing absence of mucous membrane lining, a few renal tubules imbedded in wall and small calcified masses. Note the looser, more congested tissue nearer the lumen.

Fig. 3 *(center)*, Case 21. Portion of the sac wall, showing two of the three renal fragments which were separated from the kidney by the injury. The third was loosely attached and became dislodged during the operation.

Fig. 4 *(right)*, Case 21. Kidney tissue in wall of cyst showing kidney undergoing atrophy and fibrosis.

with two other cases in which attention was directed to that detail.

The outside of the sac is composed of dense, fibrous material, more dense than the interior of the wall. The inside is smooth, but no cellular differentiation can be made out. The tissue for the most part is made up of fibrosing areas of widely differing ages, with occasional interruptions by collections of fatty cells in which there is diffuse infiltration with round cells. Collections of round cells may be seen throughout the fibrous tissue also. The sections are spotted with areas showing early calcification. There are variations in the extent and age of the fibrosing processes everywhere. In one case there was soft, yellowish, fatty appearing material imbedded in the walls. In some areas the collagen has fused down into hyaline masses. In the oldest one (seven months) these same processes had progressed further. The tissue was generally composed of fibrous cells and collagen fibrils with infiltration in a few places with small round cells. Here and there endothelial cells with pigment inclusions were noted. In the interior of the sac the tissue was spread by edema and infiltrated with lymphocytes.

The separated fragments in Case 21 showed cortical kidney tissue which was not fibrosed or otherwise distorted (Fig. 3). It had, however, undergone complete coagulative necrosis. The nuclei of the cells did not stain. Although the outlines of the cells and tissues remained, the picture was only a shadow of the original structure. Separated fragments of kidney cannot be expected to return to function if restored in continuity with the kidney at some remote date following injury. Fragments of the supposedly normal renal tissue, disconnected from its blood supply, were far from normal renal structure at the end of two months from the date of injury. The bulk of the tissue was dense, fibrous tissue, in which elements of renal parenchyma were found. Only at one place were there fairly normal elements, but even here there was much lymphocytic infiltration between the tubules and glomeruli. Elsewhere there were glomeruli to be seen imbedded in dense fibrous tissue. These were changed and showed various stages of fibrosis. Delbet mentions one kidney which showed granular atrophy.

It thus appears that the kidney, even when not deprived of its blood supply, is greatly changed in the long standing fibrosis. This

probably explains eventual autonephrectomy which took place in Case 22. Three factors probably contribute to this change in the undamaged and blood nourished tissue: one, the abnormal urinary medium in which the renal tissue finds itself bathed; another, the undoubtedly ill effect of ureteral obstruction; and, finally, involvement of the renal substance as well as the blood supply to the kidney in the extensive sac wall formation which is steadily undergoing increasing degrees of fibrosis.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of pararenal pseudo-hydronephrosis is not difficult when the case is seen at or near the end of its development, because there is no other condition which simulates as startling a sequence of developments. The history alone will establish the diagnosis if the observer is familiar with the possibility. One must, however, keep clearly in mind some other manifestation of trauma to the renal region.

Hematoma may develop about a lacerated kidney. It may occur subcapsularly and remain there. In time the plasma will separate and a cyst-like wall will form which will allow this clear fluid to persist as a subcapsular renal cyst.

Hematoma may form about the kidney as a pararenal hematoma and become encysted by the adipose capsule similar to urine in the pararenal pseudo-hydronephrosis. After a time the plasma will separate out to form a clear serum with which the cyst is filled. There has been confusion in the minds of some observers in trying to connect these plasma cysts with urinary leakage cysts with which they have no connection.

Either of these hematomas may become infected and give rise to paranephritic abscess, or there may be a hematoma form which temporarily blocks off the calyceal, pelvic or ureteral tear, into which urine may leak with the onset of obstruction to the ureter from its involvement in the fibrosing encapsulation process which is slowly taking place about the hematoma.

Delbet, after a careful survey of the conflicting opinions and evidence produced by Monod, Tuffier, Adelbert, Legueu, Wagner and others, seems justified in his conclusions that traumatic hydronephrosis does occur and that it takes place with about equal frequency with pararenal urinary effusion. This view is substantiated

by the work of Razzaboni on animals in which he found that traumatic hydronephrosis was frequently produced in those experiments by which he produced the urinary effusions. They show little of the sequence of clinical events seen in the effusions.

Extra-peritoneal cysts of congenital origin, such as teratoma, lymph cysts, diverticula of the renal pelvis and ciliated cysts related to the Wolffian body or Müllerian ducts, of course, do not have either the sequence of unusual developments shown in their history and rapid change in size, nor do they show the same character of symptomatology as do the above lesions. They present a symptomatology of a decidedly chronic nature in contrast to an acute or subacute history.

Coenen and Silberberg add one case to seven cases collected from the literature which have quite distinct findings to which they apply the name "perinephritis serosa." In this, the fibrous capsule of the kidney is split into two layers by an effusion. Since the renal capsule is a distinct structure, nourished by its own lymph and blood vessels, it readily resists spread of the effusion and encapsulates it. There is no communication of the sac, in this condition, with the pelvis, calices or ureter.

EXPERIMENTAL PRODUCTION OF THE LESION

Experimental work has been done on animals to produce the identical condition described by the above clinical observations. The outstanding contribution has been made by Razzaboni in 1922. Since his work so clearly demonstrates all the above clinical observations, it should be reviewed in considerable detail after mention has been made of experimental work of note which preceded it.

Monod (1888) believed the cases of pararenal pseudohydronephrosis were cases of traumatic hydronephrosis. He mentioned obstruction of the ureter by a clot. Yet, since some of these cases show no hematuria, he decided that hydronephrosis was not possible in all. Hawkins, Stanley, Moas, Moser and Tuffier added to the confusion in conception by inconclusive experimental work and disputations. Wagner, in 1894, concluded that true traumatic hydronephrosis and pararenal effusion existed as entities or a primary hydronephrosis might be subsequently complicated in a bruised and softened kidney, by a urinary effusion.

Delbet (1903) attempted to answer the question of why injuries

to the kidney and pelvis, which are common, are seldom accompanied by urinary effusion. He proved in the rabbit that simple laceration or section of the parenchyma did not cause excretion of urine on the cut surface. By painting the cut surface with acetate of lead and injecting potassium iodide intravenously, he got no change in the acetate of lead by urine containing potassium iodide.

He decided from the clinical reports of twelve cases which he collected, that it required a lesion of the pelvis or ureter to produce extravasation. He was convinced that urine escaping from the pelvis or ureter had not sufficient force to excavate a space for itself in the pararenal tissues. This he confirmed by experiment. After section (by a long slit) of the pelvis or ureter a small infiltration took place, but was readily absorbed. When he opened blood vessels to produce hematoma at the same time that he slit the pelvis or ureter, he found that the blood was resorbed and no pararenal effusion of urine took place. At this point he came near to discovering the obstructed ureter factor, but infected wounds from contamination misled him into believing that infection was necessary to produce the condition.

Razzaboni (1922) has produced the condition with great regularity by severing the ureter near the kidney, after which the perirenal tissues were carefully resutured. Unwittingly, I believe, he introduced the element of obstruction in attempting to exclude sepsis and to simplify the lesion by eliminating hematoma. He killed his animals at periods ranging from twenty-four hours to sixty-two days. He has made enlightening studies of the sac wall and the behavior of the kidney at various ages of the lesion which have gone far to substantiate and clarify all the clinical observations already made.

After producing the identical ureter injury in twenty-five rabbits and three dogs, he examined his lesions at various dates from twenty-four hours up to sixty-two days. In those instances in which the obstruction was, by accident, more complete, he produced hydronephrosis. In the majority of his animals he produced typical pararenal pseudohydronephrosis which appears to be identical with the condition found clinically.

His studies cover (1) the sac wall and (2) the renal substance. He divided his lesions for study into five subdivisions:

1. Lesions twenty-four to forty-eight hours old.
2. Lesions five days old.
3. Lesions twelve days old.
4. Lesions twenty to forty days old.
5. One rabbit which survived sixty-two days.

The Sac.—In these lesions forty-eight hours old or under there is no sac wall; the urine is infiltrating the pararenal tissues. The characteristic picture is that of an infiltration of round cells with some leukocytes into the fatty capsule. The most characteristic lesion produced is the effect of the urine upon the fat cells. There is a rapid lipolysis with dissolving out of the fat droplets from the fibrous reticule. The remaining fibrous tissue he believes takes the predominant part in the production of the capsule.

By five days the lipolysis is practically complete. The droplets which are discovered have an acid reaction. There is now a conspicuous round-cell infiltration which is diffuse. There is a hyperplasia of the fibroblasts which he believes has its origin in the fatty reticule.

In the twelve-day group there is a definite sac wall formed which could easily be removed together with the kidney in its entirety. There is still increased, diffuse round-cell infiltration, and fibroblastic hyperplasia is extremely pronounced. In addition there is proliferation of connective tissue. Fatty droplets are everywhere very numerous throughout the wall and are either acid or neutral in reaction—neutrality predominating. Vital staining in one rabbit specimen showed quite a pronounced amount of dead tissue in the walls of the sac.

By twenty to forty days the wall consisted almost entirely of fibrous and connective tissue with marked diminution of round cell infiltration.

In the sixty-two-day rabbit the wall had become almost pure fibrocellular connective tissue, poor in blood vessels with fine areas of cell infiltration and fine fatty granules and droplets.

In none of these animals was there ever any epithelial lining to the sac. In some there was a tendency towards deposition of an amorphous granular deposit on the inner wall of the sac which had the characteristics of dead tissue. About the outside of the sac in the older lesions was found a collagenous reticular elastic tissue

which might be young elastic tissue, but might also be considered as a residue of old fibers.

The Kidney.—Studies were made of the kidney tissue by supravital staining methods. The kidney changes fell into three divisions:

1. Cases under five days.
2. Middle group.
3. Advanced lesions.

In the five-day group the renal picture is entirely one of congestion and engorgement. Minute nuclear and cytoplasmic changes can be noted in the convoluted tubules and the capsule of Bowman.

In the middle group the congestive picture is very much less marked. By this time there is dilatation of the tubules of the medulla. Throughout their convoluted portion they have hyaline and granular content with here and there areas of epithelial desquamation. The interstitial tissues show edema and hyperplasia of the fibrous element. In some cases extensive nuclear break-up can be noted in the convoluted tubules.

In the third group the lesions of the kidney have become very pronounced, but remain of the same character as in the second group. The extent of change is dependent upon the age of the lesion with a tendency steadily towards a uniform, diffuse tubular dilatation with extensive epithelial desquamation and atrophy. The tubules are filled with amorphous material; Bowman's capsule shows hyaline degeneration. There is an extensive intertubular connective tissue hyperplasia, which is apt to be patchy with zones of markedly conspicuous connective tissue and scar formation.

Razzaboni expressed the belief that the final phase would be complete atrophy of the kidney tissue. (Refer to Case 22.)

CASE REPORTS

Case 21—A boy, five years of age, was admitted to the Children's Medical Service, Beth Israel Hospital, January 10, 1930. He was the fourth child of a healthy family. The mother had had one miscarriage.

He lives in a bungalow, well ventilated and situated in a large, open space.

The child was delivered at term by high forceps, after five hours of labor. Weight at birth was 8.5 pounds. He was bottle fed and did well. Dentition was at eight months. He sat up at six months and walked at fifteen months. He had had measles, severe in degree, at

three years of age. Diphtheria inoculation was done at two years of age.

Two months ago the child was hit by an automobile while at play. After injury he was taken to a surburban hospital where he was kept in bed for two weeks. The mother did not know the extent or nature of the injury. At the time of discharge from hospital she was told that there was a tumor mass in the abdomen, which could also be seen by x-ray.

After return home the child vomited a great deal. This eventually

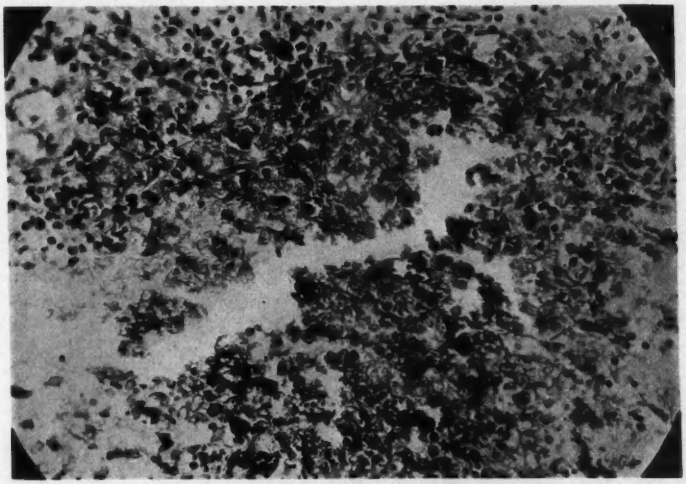

Fig. 5, Case 23. Section showing calcifying debris on lining of cyst. There are pockets of granular material embedded in loose, vascular tissue. Calcification is at the periphery of these areas.

disappeared but was present in some degree for a week. The child continued to lose weight although his appetite was good. Of late, the abdomen was becoming distended. The bowels were regular. The child complained of no pain. There was no urinary complaint. Nothing abnormal was noted by the mother in regard to the urine. The child was less active than normal and constantly complained of being tired.

Examination revealed that the child was comparatively well nourished and seemed comfortable.

His head was regular in shape, scalp clean. There were no scars. Scleræ were clear. Pupils were normal and reacted normally to light. Ears showed no discharge. Drums were normal. Nose showed very

slight discharge, passages free. Mouth showed mucous membranes normal, as were the gums. Some teeth were missing and the remainder were poor. Tongue was slightly coated and there was slight faucial infection. Tonsils were absent. There was no neck rigidity or impaired motion. Bilateral almond sized glands of anterior cervical chains.

The chest was symmetrical and expanded normally and symmetrically. It was resonant throughout and the breath sounds were normal. Heart not enlarged to percussion. Apex beat was seen and felt in the

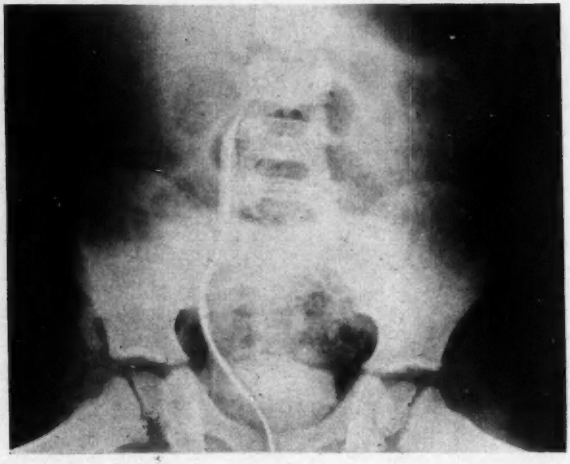

Fig. 6, Case 21. Note the massive tumor in the flank. The ureter shows clearly in its lower portion, is carried medially in the mid-portion to become lost in the sac wall. The pelvis does not fill.

fourth left interspace within the mid-clavicular line. A soft, blowing systolic murmur was to be heard over the entire precordium.

The abdomen was slightly distended, rounded and tympanitic except on the right. Here, there was a mass which was easily palpable but not visibly apparent. It extended from the costal margin to the iliac crest and to the mid-clavicular line anteriorly. The mass was soft, movable, rounded, smooth and seemed to be situated intra-abdominally. There was no external evidence of the recent injury.

Extremities showed no evidence of edema, scars or maldevelopments. Reflexes were normal.

Laboratory Data.—The patient entered the hospital with a normal temperature but a pulse averaging 100. The urine was constantly negative on ten examinations.

Red blood count was 4,500,000, previous to surgery, and the white blood count 6,700. Hemoglobin 70 per cent (Talquist). Differential count: Polynuclear 70; lymphocytes 26; large mononuclears 2; eosinophiles 2. There was slight achromia.

One stool examination was negative. Tuberculin test gave negative findings; phenolsulphonephthalein test 65 per cent in two hours and ten minutes; nonprotein nitrogen test 29 mgms.

January 11, 1930.—X-ray of the chest showed nothing worthy of remark in the lung fields.

Renal x-ray examination revealed a large kidney-shaped mass in the right side of the abdomen, the lower pole of which extended to the crest of the ilium. The left kidney was normal. There was a large, bony outgrowth from the lateral border of the crest of the right ilium.

January 13, 1930.—Genito-urinary consultant stated that "the mass has all the appearance of a renal tumor. I doubt if traumatic hydronephrosis is of more than passing interest as a possible diagnosis. Advise cystoscopy."

January 14, 1930.—An infant cystoscope was passed. The urethra was tight. Both ureteral orifices were normal in appearance and location. The right ureter was catheterized easily but no urine obtained. A right pyelogram was obtained. Impression: Right renal tumor. Function, 0 per cent.

The left ureter was catheterized later. Urine showed 15-20 red blood cells (traumatic). Function 25 per cent.

Pyelography revealed on the right side that the ureter was well outlined, displaced toward the median line by the renal mass. The pelvis was not filled. Diagnosis: Renal tumor.

January 14, 1930.—Operation was performed. Approach to the tumor was through a right loin incision. A cystic mass covered with dense scar tissue was encountered. The kidney as a whole could not be freed. The mass was found not to be a tumor, but some form of cyst. In a long operation of one hour and twenty minutes, the ureter was cut below the tumor and a portion of the large cyst removed. The cyst was filled with clear fluid. In the portion excised were several bits of kidney tissue studding the cyst wall. These tumors had the appearance of renal tissue shaped like pyramids resting on their bases. The kidney was known not to have been removed in its entirety. The wound closed to one cigarette drain. Transfusion of 250 c.c. of blood was given.

Convalescence was slow. There was considerable temperature and a small stitch abscess developed in the wound. There was much drainage from the wound of fluid which had the odor of urine.

Source of Specimen: Right Kidney.—The specimen consists of three small fragments of kidney tissue and a thick, fibrous sac to which

two pieces of kidney tissue are adherent on the inner surface. This sac had been opened before submission. It measured 18 cm. long, 7 cm. at its widest point, and 8 mm. at its thickest point. The capsule was shiny, pinkish-yellow in color. It was made up of fibrous tissue and contained several congested spots throughout. Some portions of the capsule contained a soft yellowish fatty-appearing material imbedded in the walls. At one edge of the submitted specimen was a greenish-yellow soft piece of kidney tissue which measured 2x1½x1 cm. This was firmly adherent to the sac and underlying it there was some greyish-green necrotic appearing material. In the central portion of this sac was another similar piece of kidney tissue measuring 1 cm. in diameter and appearing somewhat polypoid. There was slight congestion and necrosis around this. There was also a third fragment of kidney, which was 1 cm. x 1 cm. x 8 mm. It was detached from the fibrous sac. This was greyish-green in color and soft to palpation. lt appeared as a pyramid of the kidney and was surrounded by a fibrous tissue.

Accompanying the specimen was a small piece of ureter, 3 cm. long and 3 mm. in diameter. It was shiny, yellowish-pink in color and moderately congested.

Microscopic sections were made from various regions. Those from the nodules projecting into the cyst showed cortical kidney tissue which was not fibrosed or otherwise distorted. It, however, had undergone complete coagulative necrosis and resembled the tissue seen in the center of a large infarct. The nuclei did not stain and, although the outlines of all the cells and tissues remained, it was only a shadow picture of the original structure.

This picture ended sharply at the point where these masses were attached to the wall. At this line there was a narrow zone of congestion and hemorrhage. Adjoining this was the cyst wall. This, here and elsewhere, was largely composed of very dense acellular fibrous tissue. In some places the collagen had fused down into hyaline masses. This was most noticeable toward the inner surface. There was no lining epithelium on this surface. The surface, however, was smooth and regular, but not covered by any special layer of cells. In some places on the outside of the cyst wall were masses of kidney tissue. There were fairly well circumscribed masses of well-preserved kidney showing, however, some fibrosis at their periphery where they become insensibly fused with the dense fibrous tissue comprising the cyst wall. Embedded in the wall at various points were isolated kidney tubules. Also small masses of calcium were found distributed through the wall. Throughout the wall a few lymphocytes were found about the blood vessels, and these cells were found in somewhat larger numbers near the larger viable kidney masses.

A section of ureter included showed only edema of its wall.

Diagnosis.—Perirenal hydronephrosis (renal hygroma); infarcts of kidney; negative ureter.

The sinus continued to drain urine.

February 5, 1930.—Pyelography was done with the sinus catheterized. Re-examination showed a kidney-shaped mass in the right upper abdomen which corresponded in shape to that of a large kidney. Injection of the pelvis with sodium iodide showed the renal pelvis and calices well outlined. The upper calix was markedly dilated.

After excision of the "cyst," apparently the major portion of the kidney remained. Attempt to kill the kidney by x-ray therapy failed.

February 28, 1930.—The sinus was re-opened. The pedicle of the kidney was located and ligated. Part of the kidney was dissected out of dense scar tissue. Certainly a portion remained unremoved. The wound was packed with iodoform gauze and the wound closed.

Source of Specimen: Portion of Right Kidney.—The specimen consisted of two pieces of pinkish-yellow, moderately congested fibrous tissue from the right kidney. The larger piece was 4 cm. long, 3.5 cm. wide and 1 cm. thick. The smaller piece was 2.5 cm. long, 1.5 cm. wide and 1 cm. thick. They were similar in appearance, color and consistency. There was considerable congestion in some areas, throughout. One part was covered by a smooth, shiny, greyish-yellow fibrous lining, surrounding a roughened, pinkish-yellow fibrous appearing tissue. A few firm nodules were felt in the tissue. On section through the nodules a greyish-white fibrous tissue was seen. There was nothing worthy of remark on cross section of either piece.

Microscopic sections showed no undistorted kidney substance. The bulk of the tissue was dense and fibrous. Intermingled were many blood vessels. Striated muscle fibers were found intermingled with the fibrous tissue almost throughout. Also, there were found elements of the kidney parenchyma embedded in this dense tissue. Only at one spot was there a fair-sized collection of these elements and here there was much lymphocytic infiltration between the tubules and glomeruli. Elsewhere were several groups of glomeruli embedded in the fibrous tissue. These glomeruli showed various stages of fibrosis. There was one small area of calcification and another area showing considerable hemosiderin infiltration. One section included a hyperplastic, somewhat fibrosed lymph node. Throughout were a few perivascular lymphocytes. (See previous biopsy, January 16, 1930, on this specimen.)

Diagnosis.—Chronic perinephritis.

The operation was again long and consumed one hour and forty minutes. The patient made a slow convalescence. Drainage of urine ceased after the second operation. The patient was discharged to the

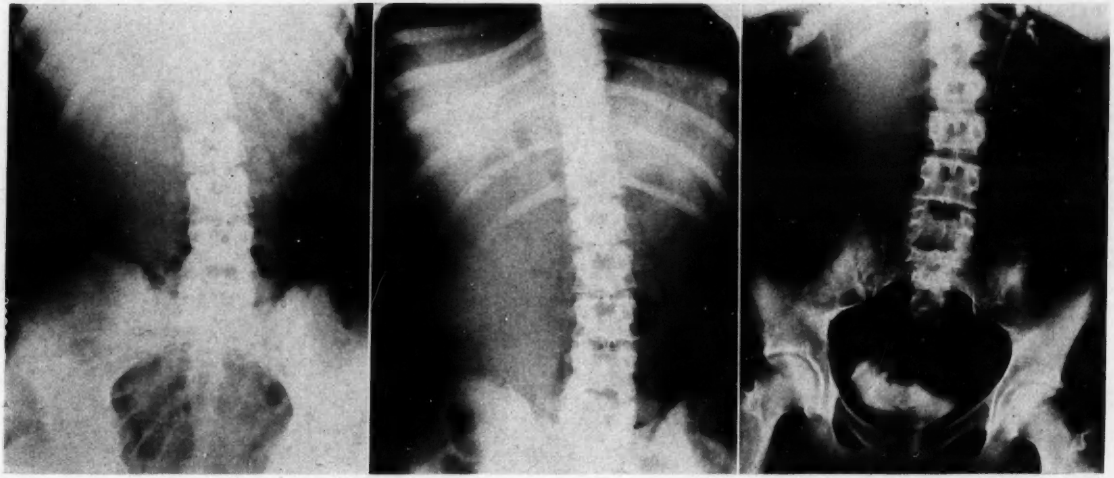

Fig. 7 *(left)*, Case 22. Size of the renal mass at the time of the original operation on the patient four months after injury.

Fig. 8 *(center)*, Case 22. Size of the tumor seven months after injury.

Fig. 9 *(right)*, Case 22. Pyelogram showing displaced, non-hydronephrotic pelvis with ureter crossing the tumor. Upper and lower ureter fills normally, but mid-ureter does not. Section from the ureter in its non-filled area is shown in Figure 1. The ureter was imbedded about midway in the thickness of the sac wall.

Out-Patient Department with a slight degree of purulent drainage on March 14, 1930.

By May 6, 1930, the wound became dry and clean. There was an area of slight granulation at the posterior end of the incision at the site of the wick.

During May and June the patient was seen in the Surgical Out-Patient Department for bilateral cervical adenitis. These glands subsided and the patient was sent to the country for four months.

Owing to change of address the patient has not been followed further than June 20, 1930, at which time the child seemed entirely recovered from both the renal condition and the adenitis.

Case 22.—A schoolgirl, thirteen years of age, was seen in the Addison Gilbert Hospital, Gloucester, Mass., with Dr. Burrell, on April 16, 1934, seven months after an automobile injury and three months after an exploratory operation on her right side.

She was a healthy, tall child for her age who had always been well. She was normal in school activities, had been athletic and had been a vivacious member of a large family.

Seven months previously she was in an automobile accident and was injured as an occupant of one of the wrecked cars, but the exact nature of the injury was not known. She was taken immediately after the accident to a nearby hospital, where she remained for three weeks.

There had been bleeding through the bladder, fever of some degree, from her mother's story, and a plain x-ray showed no stones or any data on which any action was taken. Apparently no pyelography was done. Bleeding ceased before she left the hospital. She was not well at the time she left the hospital. Evidently she went home as an ambulance case and remained at home chiefly as a bed patient.

At home she continued to run a temperature of septic type, ranging in the evening as high as 100°. The urine became clear and there was no evidence of pyelitis. The white count remained high, ranging from 15,000 to 24,000. Gradually some anemia developed. She was comfortable when lying down, but moved about with some tightness and feeling of discomfort in the right side, which was the site of her injury.

In January, 1934, she was moved into the Gloucester Hospital. X-ray was taken. The kidney was about three times normal size. It seemed longer than normal and its outlines indistinct. The temperature remained above normal. Urine analysis gave entirely negative results. Some slight tenderness was present over the right costovertebral region.

Dr. Mooring explored the kidney on the diagnosis of chronic perirenal abscess. He found a smooth anchored kidney which did not have the appearance of tumor. He could find no abscess. By means of a syringe a puncture was made where he thought the pelvis should

be. Clear urine was obtained. This was not examined further than to note its clearness and odor.

Convalescence was uneventful except that the child evidently was not cured.

On returning home she continued life as before. There was never any more temperature. The urine remained clear. In the three months spent at home, previous to April, the kidney grew tremendously in size until it projected high from the right side of the abdomen. The child gained weight, had a good appetite, slept well and regained some of her color and looked better than at any time since the accident.

Plain x-ray showed a tremendous enlargement of the right kidney. Tumor was smooth, extended beyond the midline and well down into the true pelvis, as well as up as high as the diaphragm.

Cystoscopy revealed that the bladder urine was celar and negative. The bladder showed no signs of inflammation or pressure from outside. Both ureters were in normal position and easily catheterized to about normal distance for a child of her size; clear urine drained from the left. No urine drained from the right catheter.

The red test showed a normally functioning left kidney with dense color rapidly secreted. There was no function at all from the right.

Pyelography showed this right kidney to be greatly enlarged and the pelvis to be about normal in size, rotated and lying at the extreme upper end of the tumor. The ureter crossed obliquely down the middle of the tumor, seeming to be on the anterior surface. It was normal in size and the only abnormality seemed to be that pressure of the tumor against the abdominal wall quickly cleared the injection fluid from the mid portion of the ureter. The intestines were all pushed to the opposite side of the spine. The tumor mass was not movable and yet, from the history and from recent operation, I was not sure that it could be removed.

One would like to make the diagnosis of tumor because of the rapid growth. Improvement of the child in health and weight was somewhat against that diagnosis. There were no evidences of metastasis in the lungs or bones. There was a faint hope that the lesion was an extrarenal hydronephrosis from trauma.

April 11, 1934.—Operation was performed at the Addison Gilbert Hospital. Pre-operative diagnosis: (1) Renal tumor; (2) extrarenal hydronephrosis.

Transperitoneal approach was made to the mass. There was a firm, somewhat nodular tumor of great size extending over to the midline and extending well down and into the true pelvis and as far upward as one could reach to the diaphragm. This was covered by large, dilated veins and had the appearance of a solid tumor.

The posterior layer of peritoneum was opened over the tumor mass and it was explored downward and toward the median line. The internal iliac vein and artery were considerably elevated on the anterior

surface of the tumor toward the midline; the vena cava was carried up on to the surface of the tumor a distance of 2 inches. Posteriorly it was adherent to the abdominal wall.

The lower portion of the tumor was quite well freed by careful dissection. On freeing the vena cava a small vein was cut along the surface of the vena cava and a ligation had to be made in the wall of the vein. When the dissection had been carried up to the upper third of the kidney anteriorly, it was noted that there were several layers of inflammatory type tissue which went to form a capsule. When these were freed, I accidentally entered the cavity, with the escape of about one quart of fluid which had the odor and color of urine. This exposed a very large, very thick walled cavity which extended up until one could feel the kidney and could visualize the lower pole from which there seemed to be a granular opening, as though it were the site of rupture at the time of accident.

Further exploration made it seem very unlikely that the whole sac could be resected, or that the kidney could be removed, because it was firmly bound in extensive fibrosis. A search was made for the ureter, but it could not be found.

It seemed wise to marsupialize the cavity and in order to do so a portion of the anterior wall must be excised. In excising this, the stump end of the ureter was found about 1 inch deep in the firm, fibrous mass.

Since the kidney had had no function at the time of cystoscopy and the opening of the kidney into the sac might not be patent, the ureter was ligated. The marsupialized sac was then packed with gauze and the wound closed. Peritoneum was so closed as to wall off the marsupialized sac.

If the cavity failed to close on account of leakage of urine, it was felt that a nephrectomy might be necessary.

The patient was in fair condition at the end of the operation. All bleeding was controlled and she was sent to the ward.

April 13, 1934. Source of Specimen: Sac of Kidney Cyst.—The specimen consisted of a disc-shaped piece of firm, discolored tissue, which measured 5 cm. in diameter and 1.5 cm. in thickness.

In sections, the tissue was generally composed of fibrous cells and collagen fibrils, infiltrated in a few places with a few lymphocytes and here and there containing some endothelial cells with pigment in them. Some of the tissue was spread apart by edema. Areas of necrosis or giant cells were not apparent. Along one border, the tissue was not dense and was infiltrated with numerous lymphocytes. The cells were without signs of active proliferation.

Opinion: The tissue from the sac was largely composed of organized tissue which showed chronic inflammation. It was without evidence of tuberculosis or malignancy.

Convalescence was uneventful except for continued leakage of a pale

urine from the sinus. The wound healed by first intention except for the urinary sinus at the site of the drains.

In succeeding months the patient returned to robust health, but there remained a small amount of leakage from a very small sinus. A mass about twice the size of a normal kidney remained up to February, 1935. Since then, both the sinus and the mass have disappeared.

Fig. 10, Case 23. Pyelography in this patient showed the lower ureter well outlined. Above the brim of the pelvis it is carried medially to be lost in the tumor mass. A flattened or dilated pelvis displaced outwardly can be noted with incomplete filling. The injection was made by retrograde pyelography.

This appears to have been the result of renal destruction by the process encroaching on the kidney, presumably by fibrosis.

Case 23.—A schoolgirl, aged eight years, was admitted to the Addison Gilbert Hospital, Gloucester, Mass., September 15, 1934. She was a healthy girl in a family of father, mother, three sisters and one

brother. The family was one of moderate means. The children were well and intelligently cared for.

She had had measles, mumps and whooping cough before the age of six years; since then nothing more than colds. No injuries and no operations were reported. The child had always been thin, but active, happy and a good student in school.

The patient was brought into the hospital in an ambulance. She was pale, with rapid pulse and evidently in considerable pain. The temperature was 98.8; pulse rate 100; respirations 32, but there was no labored breathing or evidence of lung embarrassment. Her urine was bloodly and the left side of the abdomen very tender.

Her mother gave the following history. On September 1, 1934, while playing in her home she tripped and fell heavily across a pail, striking on her left side. The injury was not considered serious, but the child was pale. There was no evidence of serious bruising about the body, but the mother noticed bleeding "from the vagina." The child was in the care of Dr. Philbrick, who considered her condition satisfactory, but kept her in bed. She complained of pain in the left side of her abdomen. There was no evidence of injury to the viscera and the abdomen remained flat. The bowels moved normally. "Vaginal" bleeding continued for only two or three days. The temperature record was not kept, but evidently was not striking.

On the thirteenth day after injury she was seen in consultation, then sent to the hospital in an ambulance. The occasion for this procedure was increasing pain, tenderness and spasm in the region of the left kidney and recurrence of bleeding. Dr. Mooring, who had primarily seen the patient described in Case 22 in this series, diagnosed the condition as pararenal hydronephrosis.

On reaching the hospital the following notes were made as to her condition. The child was very pale and evidently in pain. She complained chiefly of abdominal pain and also of pains in both arms and legs. The head was normal except that three teeth were missing. The tonsils were somewhat enlarged. The mucous membranes of the mouth were very pale. The skin was not hot. The heart sounds were regular and of good quality, but the rate was very rapid. The abdomen was very rigid, not distended, but very tender along the left flank and left side of the abdomen in front. There was constant pain in the left kidney region. Urine remained very bloody.

From September 5 until October 12 the patient showed considerable improvement. There was continued soreness in the left side and much spasm, but the bleeding from the urine subsided. There was never a temperature above 100 degrees. The pulse ranged from 88 to 102.

On October 12, 1934, I saw the patient, in consultation. There was no evidence of vaginal injury. The child looked pale, seemed not to be in much discomfort, had a soft abdomen except that the region of

the left upper quadrant was occupied by a definitely palpable mass situated in the region of the left kidney. This mass was palpable beneath the rib margin, seemed hard, fixed, non-fluctuant and extended to within a finger's breadth of the crest of the ilium. It extended but a short distance towards the midline. It was tender to palpation.

A number 16F. single catheterizing cystoscope was easily passed. The bladder mucosa was very pale, but not injected or dull. There was a clear jet from the right ureter. No jet was noted from the left. The urine from the bladder showed acid reaction, no albumin, no sugar and the sediment was negative. There were no red blood cells, no bacteria in stained sediment, no excess of leukocytes and no casts. There were many epithelial cells.

The catheter passed readily up the right ureter and the urine flow was clear. This sediment was negative. The phthalein output was of deep color. The left catheter was obstructed in the middle third of the ureter. There was no flow of urine. Boric acid solution injected was returned turbid. There was no albumin present. The sediment showed numerous epithelial cells, 1-5 white blood cells, no red blood cells, casts or bacteria in stained sediment.

Bilateral pyelography was done.

X-ray report stated that the right kidney shadow was normal in size, shape and position. Pyelography showed normal calices, pelvis and ureter. The left kidney shadow could not be seen, but the entire left flank was dense. Pyelography showed the kidney pelvis carried away from the spine laterally and situated higher than normal. The ureter was carried inward toward the spine in its mid third and became tortuous as it approached the mass in the left flank; from here to the pelvis it was indistinct. Its lower portion was normal. The pelvis and calices were extensively dilated. There was no evidence of free fluid in the flank.

Laboratory data on October 12, 1934, were as follows: Morning urine was amber in color, acid, with a specific gravity of 1.022. Albumin smallest possible trace, sugar 0; no bile; few calcium oxalate crystals: amorphous urates; 2-10 finely granular and hyaline casts; 2-4 red blood cells; 2-6 white blood cells.

Findings were similar on October 14. Hemoglobin was 95 per cent, color index 1.2; red cell count 3,760,000; leukocyte count 15,800; differential count—polynuclears 73 per cent; transitional cells 1 per cent; large mononuclears 1 per cent; small lymphocytes 25 per cent. Intramuscular phenolsulphonephthalein test: First hour 25 c.c., 20 per cent; second hour, 50 c.c., 30 per cent.

Operation was advised under the diagnosis of pararenal hydronephrosis.

Permission for operation was granted on October 18. After cystoscopy the patient's condition remained about the same until the 18th, when there was marked increase in pulse rate to 160 per minute, with

the temperature remaining near normal. There was marked increase in the size of the tumor on this date. By the morning of the 19th the lower borders of the tumor disappeared within the crest of the ilium. The tumor was several times the size noted on the day of cystoscopy and could be seen protruding through the abdominal wall to about twice the height of the right side. The intestines seemed not to be distended. The mass now extended fully 2 inches beyond the midline with a curving edge convexed toward the right at its midpoint.

Operation was performed October 19, 1934, the forty-ninth day since injury, the thirty-fifth day since the first untoward symptoms at home, the thirty-seventh day following subsidence of bleeding from the urine and the seventh day since the tumor became definitely palpable and demonstrable by x-ray. It was eighteen hours after the tumor suddenly increased in size. An oblique left loin incision was made. Beneath the muscle layers there was no perirenal fat noted. There was a massive, thick, dark red colored cyst-like mass which was definitely fluctuant. This was punctured with a large bore needle on a syringe and cloudy, pus-laden fluid removed. A window was then made in the anterior wall of the sac and a very large quantity of turbid fluid removed which contained necrotic blood clot, slough, yellow debris and had the odor of stale urine. Specimens from the sac wall were saved for pathologic study and a specimen of the fluid for analysis. On exploration of the sac from within, it was found to extend downward as far as the brim of the true pelvis, upward beneath the diaphragm and medially beneath the aorta and vena cava. The sac seemed to surround the kidney so that the latter remained free within the sac, except where its ureter and pedicle were lost in the thick wall posteriorly. The course of the ureter could be traced in part. Inferiorly the ureter lay along the left lateral border of the spine for a distance, then turned abruptly outward to become lost in the tissue forming the walls of the sac. The lower third of the kidney had been broken across and the fragment lost in the sac wall, since it could not be located free in the sac. The broken end of the kidney showed adherent old clot. A sinus could be noted into which a probe could be passed to the pelvis. The upper pole of the kidney was abnormally shaped, club-shaped, with thin walls. On removal of the clot from the fractured surface of the kidney there was free bleeding. This indicated nephrectomy. An attempt was made to free the pedicle sufficiently from the sac to allow safe ligation. Before this could be accomplished the patient's condition became uncertain with some evidence of shock. A clamp was applied to the pedicle close to the kidney. This was left in place. The wound was closed about two cigarette drains. After closure of the wound the patient's condition rapidly improved and she left the operating table in fair condition.

Analysis of fluid from the sac was made by Dr. Schlesinger. The fluid was cloudy and contained fragments of blood clot and debris. It

had the odor of stale urine. Analysis showed the following to be present in 100 c.c. of fluid: uric acid, 12.1 mg.; creatinin, 6.3 mg.; urea nitrogen, 21.9 mg.; NH_3 as N, 29.4 mg. Culture from the fluid was sterile at the end of five days.

Pathologic Report.—Two pieces of tissue, apparently parts of a cyst wall, were submitted for pathologic examination. They measured about 1.5 and 2.5 cm. in diameter respectively. One surface of the tissue was smooth, while the other was ragged. Microscopic examination of the tissue revealed a thick wall of fibrous and fatty tissue. One surface was smooth, but no cellular differentiation could be discerned. The tissue for the most part was made up of fibrosing areas with an occasional interruption by collections of fatty cells in which could be seen diffuse round-cell infiltration. Collections of round cells could be seen throughout the fibrous tissue also. The sections were spotted with areas showing early calcification. There was variation in the extent and age of cicatrization everywhere, but everywhere the stage was early. No cellular differentiation could be made out anywhere. No structure could be identified.

Diagnosis: Chronic inflammatory tissue with beginning calcification.

Hospital Notes.—

October 20, 1934—The patient's condition was fair. Temperature was very high (103 to 104); pulse 140 to 150 per minute. Nausea. Dilute urine was voided after hypodermoclysis.

October 23.—There had been no bleeding and only slight amount of draining from the wound. Temperature and pulse remained high. Condition of the patient was fair. One cigarette wick was removed.

October 26.—The patient was much improved. The other cigarette wick was removed. There was considerable purulent discharge from the wound.

October 30.—Sutures had all been removed. The wound had healed by first intention up to the drainage area. Clamp was removed from pedicle. There was profuse purulent discharge. The patient ate and slept well.

November 1.—The patient appeared very frail and weak. Anemia diet with forced feedings was prescribed.

December 1.—The patient had gained a great deal. The discharge was less.

December 13.—The patient was able to walk unassisted. Discharge had ceased. Wound was healed. Temperature was normal.

The patient is now in excellent health with uninfected urine and shows only the operation scar.

COMMENT

1. Pararenal pseudo-hydronephrosis, while a rare disease, is worthy of recognition as a disease entity. It is diagnosable by modern urologic measures.

2. Neglected, it results in renal destruction and is capable of causing death to the patient.

3. Its characteristic symptomatology is continued disability. Discomfort after improvement from renal injury might reasonably be expected to occur, followed at some remote date by exacerbations of symptoms, after which renal tumor appears. Hematuria may be absent, but if present is usually of short duration. Temperature rise is not to be expected and is usually low or absent during the quiescent stage of the disease. It may be more marked during exacerbation of symptoms and rapid growth of the tumor. The white cell count is usually low. Even in the quiescent stage the disease is debilitating.

4. There is no evidence by cystoscopy that the ureter is functioning in any of the cases studied by cystoscopy.

5. A peculiar combination of three factors is necessary for production of the disease:

(1) Trauma or perforation which opens calix, pelvis or ureter within the fatty capsule of the kidney.

(2) Maintenance of the opening beyond the normal healing period.

(3) Acquired or pre-existing ureteral obstruction. The acquired form is more common.

6. The disease is rapidly destructive to the kidney. Preservation of the kidney clearly depends upon early recognition of the disease. Relief of the ureteral obstructive factor also is indicated if conservative surgery is to succeeed.

7. Separated fragments of kidney tissue are usually not sufficiently viable to allow of reparative procedures at dates remote from the injury.

8. Repair of the lesion is indicated where the condition appears soon after injury. It is contra-indicated in late cases.

9. Treatment by drainage or paracentesis can be expected to fail except where the renal damage is sufficient to produce autonephrectomy.

10. Most late cases require nephrectomy for cure. The operation is not always possible because of the fibrous sac wall which may enclose the major portion of the kidney and its pedicle. Subterfuges for destruction of the kidney short of nephrectomy may be an aid in such situations.

11. Demonstration of urine in the sac or an opening connecting with the pelvis is necessary to differentiate the disease from serum cysts.

12. More general use of cystoscopy or intravenous urography soon after injury might disclose the nature of these lesions early enough to allow conservative measures.

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REFERENCES

BIANCHETTI, CARLO FELICE: Arch. Ital. di Urol., 3:362, 1927.
BONNOIT, A., and DOUILLET, M.: Jour. d'Urol., 37:6, 1933.
BLOCK, WERNER: Ztschr. fur Urol., 26:788, 1932.
DAMM, ERDMAN: Ztschr. fur Urol., 26:399, 1932.
DELBERT, PAUL: Rev. de Chir., Vol. 28, 1903.
KAISER, K. J.: Ztschr. fur Urolog. Chir., 6:286, 1921.
NISIO, GUISEPPE: Arch. Ital. di Urol., 4:49, 1927-1928.
OSGOOD, ALFRED T.: Dean Lewis' The Practice of Surgery, Vol. 8.
PICARD, EDWIN: Archiv fur Klin. Chir., 115:636, 1921.
RAZZABONI, GIOVANNI: Arch. Ital. di Chir., 6:365, 1922.
STIRLING, W. CALHOUN: Med. Ann. Dist. Columbia, 3:41, 1934.

CARBUNCLE OF THE KIDNEY

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The carbuncle of the kidney is accurately defined by the term which names it. It is a circumscribed, multilocular abscess of the renal parenchyma, involving in varying extent the substance of the organ. It is probably metastatic in most instances, and usually arises from a primary focus of infection elsewhere in the body. The causative organism is most frequently the Staphylococcus pyogenes aureus. The clinical interest of the renal carbuncle lies in its relative rarity and in the difficulties attendant upon its diagnosis.

The condition was first described by Israel in 1905, before the Free Society of Berlin Surgeons, and since that time there have been sixty-five additional cases recorded.*

Case 1.—The original description by Israel gives the clinical picture of this disease. His patient, an army officer, aged thirty-seven, was well until he developed a carbuncle of the neck. Several weeks later when he had almost recovered, he was kicked in the left lumbar region. Immediately following this trauma he suffered a brief attack of severe pain in the left flank which recurred the next day, when his temperature rose to 102. The fever and discomfort continued for three weeks, at the end of which time he was brought to the hospital.

Upon examination a large fluctuant mass was found in the left lumbar region; muscle resistance and tenderness extended even to the right side of the abdomen. The urine contained a slight trace of albumin, many leukocytes, and a few red blood corpuscles.

Operation revealed a large perinephritic abscess, behind the left kidney. A nephrectomy was done. In the mid-portion of the convex border of the kidney there was found a swelling 8x5 cm., covered on its outer surface with granulation tissue. The upper and lower poles appeared to be normal. On section, the middle third of the organ presented the characteristic appearance of a carbuncle extending from the

*The following cases have been reported since this paper was written:

1. Taylor, William N.: Carbuncle of the kidney. Amer. Jour. Surg., 22:550-556, (December) 1933.
2. Kohle, P. J., and Beacham, H. T.: Bol. Assoc. med. de Puerto Rico, 25:509-519, (August) 1933.
3. Swartz, E. O.: Two cases. Jour. Med., 15:194-202, (June) 1934.
4. James, T. G. I.: Brit. Jour. Urol., 6:156-159, (June) 1934.
5. Lazarus, J. A.: Eight cases. Amer. Jour. Surg., 25:155-162, (June) 1934. (The first two cases in this reference are herein reported in detail.)
6. Gardini, G. F.: Arch. ital. di. urol., 11:504-520, (August) 1934.
7. Szocsvay, S. Von: The diagnosis and treatment of renal carbuncle. Ztschr. j. urol. chir., 40:70, 1934.

medulla to the capsule. The Staphylococcus aureus was found on culture. Israel states, finally, that his patient recovered after a convalescence which was complicated by empyema upon the right side.

Case 2.—Zinn's[29] first case was a man of thirty-six, who, four weeks after a furuncle on the nose, developed chills and fever of unknown origin with gradual onset of pain in the right lumbar region, which was present at first only on motion; later the pain became constant. Physical examination revealed an enlarged right kidney, and pain in the right lumbar region on pressure. The urine was normal; cystoscopy showed a normal bladder. In the renal function test, indigocarmin appeared from the left ureter in ten minutes, and from the right in twenty-four minutes. Pre-operative diagnosis: Question of metastatic kidney, or right perinephritic abscess. Operation revealed a carbuncle in the upper pole of the right kidney. Etiology: Staphylococcus aureus. The patient had a stormy postoperative course, and died.

Case 3.—Zinn's[29] second patient, a man of twenty-five, four months after furunculosis of the neck, developed headache, malaise, and fever of 101. Typhoid fever, pleurisy, and pneumonia were considered as diagnoses. One week later he had recurring chills with fever. Physical examination revealed dullness of the right chest. The right kidney was palpable and painful on pressure. The urine was normal. Pre-operative diagnosis: Metastatic abscess of the kidney following furuncle, and right pleural effusion. Operation revealed a carbuncle in the upper pole of the right kidney. Operation: Incision and drainage. The patient recovered.

Case 4.—Zinn's[29] third patient was a man of fifty-five, who, four weeks after recovery from incision of a carbuncle of the neck, developed fever and gradually increasing pain in the left lumbar region. Physical examination showed swelling in the region of the left kidney, and pressure over the left eleventh and twelfth ribs increased the pain. The urine was normal. Pre-operative diagnosis: Metastatic abscess of the left kidney. Operation revealed a carbuncle in the upper third of the left kidney. The kidney was incised and drained. The patient recovered.

Case 5.—Zinn's[29] fourth patient was a woman of twenty-four, who, three weeks after having a furuncle on the arm, developed fever, headache, chills, anorexia, weight loss, and pain in the left eleventh intercostal space, which was increased by respiration. Physical examination elicited spasm over the left lumbar region and tenderness on pressure in the left costovertebral angle. Later, swelling developed in the region of the left kidney, accompanied by increase of pain and spasm. Pre-operative diagnosis: Metastatic abscess of the left kidney. Operation revealed a carbuncle involving the upper third of the left kidney. This was incised and drained. The patient recovered.

Case 6.—Israel[9] reports another case, a man who, five weeks after furunculosis with pyelonephritis, had a nephrotomy and renal drainage, at which time a carbuncle was found in the middle third of the kidney. The patient recovered.

Case 7.—Barth[1] reports the case of a man of forty-three, who, four weeks after having a carbuncle of the neck, developed a pain in the flank. His urine showed the slightest possible trace of albumin and many white blood cells and casts. Operation, thirty-eight days after the onset, revealed a carbuncle involving the upper third of the kidney. The carbuncle was incised and drained. Four weeks later a nephrectomy was done.

Case 8.—Barth's[1] second case, a man of twenty-eight, without any recognized previous infection, developed a high fever and pain in the right lumbar region, which lasted for three weeks. On physical examination a tender mass was felt in the right kidney region, and the urine contained red and white blood cells and casts. At cystoscopy, the indigocarmin appeared from the left kidney in eight minutes, and from the right in fifteen minutes. Four or five weeks after the first appearance of symptoms, the kidney was incised and drained. A week later, a nephrectomy was done, at which time a carbuncle was found involving the lower third of the right kidney. The patient recovered.

Case 9.—Barth's[1] third case, a man of thirty-four developed furunculosis of the gluteal regions. During the course of this illness, a painful mass appeared in the right kidney region. The urine showed albumin, many red blood cells, and a growth of Staphylococcus aureus on culture. Cystoscopy showed a normal bladder, and the indigocarmin appeared from the left kidney in ten minutes, although no dye appeared from the right side at the end of thirty-five minutes. Preoperative diagnosis: Carbuncle of the kidney. A nephrectomy was done. At operation a perirenal abscess and a carbuncle of the middle third of the kidney were found. The infecting organism was identified as Staphylococcus aureus. The patient died.

Case 10.—Barth's[1] fourth case, a boy of ten, without any known infection previously, experienced an acute onset of chills and pain in the right lumbar region. Five days later the kidney was incised and drained. At the end of two weeks, his fever recurred, and four weeks after the drainage a resection of the upper third of the kidney was necessary. A carbuncle which occupied the upper third of the kidney was found, and Staphylococcus aureus was identified as the infecting organism. The patient recovered.

Case 11.—Barth's[1] fifth patient, a young man of twenty, without any previous infection, developed pain in the right lumbar region. A mass could be felt in the right kidney region, which was painful on

palpation. He had a temperature of 101. His urine contained albumin and red and white blood cells, and on culture B. coli and Staphylococcus aureus were found. At cystoscopy the bladder was found to be normal. Microscopic sediment from the right kidney showed white blood cells; B. coli and Staphylococcus aureus were found on culture. Urine flowed slowly from the right kidney; flow from the left side was normal, and the left kidney urine was normal. Pre-operative diagnosis: Carbuncle of the kidney. Nineteen days after onset a nephrectomy was done. At operation a carbuncle was found on the posterior surface of the middle third of the kidney. This patient's recovery was complicated by an abscess of the prostate, which was drained.

Case 12.—Eisendrath's[7] first patient had a carbuncle of the back. Eight weeks later he developed pain in the right lumbar region and in the right upper quadrant. Temperature was 102. On physical examination the right lung showed diminished excursion, and tactile fremitus was absent at the right base. Liver dullness was observed to be higher than normal, and the right kidney was palpable and tender. The temperature was 103 and the white blood count 27,000. At cystoscopy the left ureter function was normal. X-ray showed irregularity of the lower pole of the right kidney and a high right diaphragm. Pre-operative diagnosis: Perinephritic abscess. The kidney was incised and drained. Later a nephrectomy was done and a carbuncle of the lower third of the kidney was found. Etiology: Staphylococcus aureus. The patient recovered.

Case 13.—Eisendrath's[7] second patient, a woman, had had attacks of right upper quadrant pain lasting six or seven days, since a postpartum pyelitis four years before. She complained of a tender mass in the right kidney region. Temperature was 106.8. Physical examination revealed a large tender mass in the right kidney region. At cystoscopy the right ureteral orifice and trigone were observed to be swollen and red, and the mucosa edematous. Pus was seen to come from the right ureter. X-ray showed an enlarged right kidney. Pre-operative diagnosis: Acute infection of the kidney. Fourteen days after onset of acute illness a nephrectomy was performed. At operation a carbuncle of the middle third of the kidney was found. Etiology: Staphylococcus aureus. The patient recovered.

Case 14.—Kretschmer's[12] first patient was a woman of thirty-five, who, seven months previously, had had a felon on the right thumb incised, and a month later a piece of necrotic bone removed. During the course of this infection she gave birth to a child. Three months later she developed an acute pain in the left side which was diagnosed as prolapsed kidney; a pad was prescribed. The pain continued and was accompanied by severe abdominal colic with nausea half an hour before meals. She had painless urinary frequency (nocturia—5); the urine was brown. On physical examination a large, hard, irregular

mass was palpable in the left upper quadrant, which moved slightly with respiration and was very tender on pressure. Pressure over the back caused a pain which radiated to the groin. The white blood count was 14,000. At cystoscopy there was no flow of urine from the left ureter. The right kidney urine was sterile and normal, and the thirty-minute phenolsulphonephthalein test was 58 per cent. The bladder urine showed colon bacillus on culture. Three months after onset a nephrectomy was done. The kidney was enlarged. On the anterior surface there was a carbuncle, irregular and nodular in contour. Etiology: Hemolytic staphylococcus. The patient recovered.

Case 15.—Kretschmer's[12] second patient was a man of thirty-four, who had had a carbuncle of the neck. Two months later he developed pain in the lower abdomen accompanied by a temperature of 104.6 and profuse sweating. He was discharged from the hospital at the end of two weeks, and one week later his temperature suddenly rose to 102. He had nausea and vomiting, and hematuria and dysuria for three days. On physical examination the right kidney was found to be enlarged and tender, with some rigidity of the lumbar muscles. The white blood count was 16,800; Widal test negative; blood-sugar 143; urea 27; non-protein-nitrogen 43. At cystoscopy the cell count of the right kidney urine was 130, and on culture the urine from this side grew Staphylococcus albus. Dye appeared from the right kidney in thirty minutes. A pyelogram showed traces of solution extending from the twelfth dorsal to the second lumbar vertebra. Sixty-three days after onset a right nephrectomy was done, and a carbuncle 4x3.5 cm. in diameter, composed of multiple small abscesses, was found in the middle of the right kidney. The wound healed following operation, but the patient ran a febrile course and never fully recovered. He developed hematuria, at which time a diagnosis of abscess of the left kidney was made, and he later died. At autopsy a carbuncle 3x10 cm. in diameter was found involving the middle third of the left kidney.

Case 16.—Horn[8] reports the case of a man of thirty-five, who had a carbuncle of the neck which healed after two months. At this time his urine was known to be normal although he complained of frequency of urination. Soon after admission to the hospital he developed dysuria and retention, weight loss, and weakness. The kidneys were not palpable. Cystoscopy showed cystitis and the bladder urine was turbid. There was a slight flow of clear urine from the right kidney, which gave an acid reaction and contained a few red blood cells. There was a good flow of clear urine from the left kidney, which gave an alkaline reaction and contained epithelial and degenerated cells. The prostate was hypertrophied and a suprapubic prostatectomy was done. There was no operation on the kidneys, and the patient died with symptoms of septicemia. At autopsy a right perirenal

abscess and a carbuncle which involved three-fourths of the kidney, were found. Etiology: Staphylococcus aureus.

Case 18.—Colmer's[5] case, a girl of ten, who, two weeks after recovery from a recurring severe throat infection, developed a pain in the left lumbar region, accompanied by frequent vomiting, headache, anorexia, and chilliness. Two weeks after onset of these symptoms she had a temperature of 101. Tenderness and spasm were present in the left kidney region. The urine contained albumin and a few white blood cells. One week later she developed hematuria. Her white blood count was 17,500. A pre-operative diagnosis of perinephritic abscess was made thirty-five days after onset of illness. The kidney was incised and drained. Ten days later a nephrectomy was necessary. A perirenal abscess and a carbuncle involving the middle third of the left kidney were found. The patient recovered.

Case 19.—Riazanzeva's[24] first patient, a woman of fifty-six, had a temperature of 100, and was very sick with a large carbuncle on the back for three weeks. Nine days after it was incised she developed a moderately severe pain in the right lumbar region. On physical examination tenderness was elicited over McBurney's point, and rigidity over the right half of the abdomen. There was dullness 3 cm. below the costal margin on the right, which was continuous with the dullness over the kidney region. The kidney was not palpable. The urine was normal on admission, but seven days after operation contained albumin and many white blood cells and casts. The white blood count was 15,000. Pre-operative diagnosis: Question of kidney or gall-bladder disease. Thirty-five days after onset an exploratory laparotomy was performed. The gall bladder was found to be normal. The peritoneum on the right posterior wall of the abdomen showed white infiltration. The abdomen was closed and the right kidney incised and drained, at which time a carbuncle 4 cm. in diameter was found. The patient died twenty-four hours after operation. Autopsy showed an extensive carbuncle of the right kidney.

Case 20.—Riazanzeva's[24] second case is one of T. J. Grekow's which he reports. A man of twenty-nine developed an acute knife-like pain in the right back two weeks after a fall of nine feet. The pain recurred with chills and a fever of 101. He developed painful urination four days later. On physical examination extreme tenderness was elicited in the left kidney region, and moderate tenderness on the right. The urine was normal at first, but later contained albumin and red blood cells. The white blood count was 8,000. Eighteen days after onset a left nephrectomy was done, and a carbuncle 7 cm. in diameter, showing Staphylococcus on culture, was found. The patient recovered.

Case 21.—Klumow's[11] patient, a man, during three months before observation, had headache with chills and a temperature of 101 for

a few days on three occasions. Two months after the last attack he was confined to bed with fever. Later he developed a moderately severe pain under the right ribs. Physical examination showed the right kidney to be enlarged to 4 cm. below the costal margin. There was tenderness in the right upper quadrant; resistance in the right lumbar region, although there had been none at first. The urine was normal. The red blood count was 4,500,000, and the white blood count 10,000 to 12,000 (later 34,000) and the hemoglobin 65 per cent. One hundred days after onset, an exploratory laparotomy was done. The abdomen was found to be negative so the right kidney was explored. A carbuncle involved the lower third of this kidney. A nephrectomy was done and the patient recovered.

Case 22.—Reschske[23] reports the case of a young woman of seventeen, with pustular acne on the forehead. She complained of malaise and pain in the left side of the abdomen for three weeks. Typhoid fever was at first suspected. The patient became worse and developed pleurisy on the left side. On physical examination the kidney was not palpable, but there was tenderness in the left upper quadrant and in the left kidney region. The urine contained white blood cells. The white blood count was 14,800. On cystoscopy 5 c.c. of clear urine containing white blood cells appeared from the left ureter in ten minutes. Thirty days after onset, a carbuncle in the lower third of the left kidney was excised with drainage. Etiology: Staphylococcus aureus. The patient recovered.

Case 23.—Reschske's[23] second case, a man of fifty-five, after having several carbuncles and furuncles, experienced a mild malaise with no definite complaints, for several weeks, and then developed a sudden severe pain in the bladder region. On physical examination spasm was found over McBurney's point, and more resistance to palpation in the right kidney region than in the left. Urinalyses were negative, but seven weeks later the urine contained albumin, many white blood cells, and casts; on culture Staphylococcus infection was found. The white blood count was 24,000. An exploratory laparotomy was done, at which time the abdomen was found to be full of thin pus, and a perforation from a large renal carbuncle oozed pus in the region of the right kidney. The abdomen was closed with drainage. On culture, the pus showed Staphylococcus. The patient died six days later. Autopsy revealed a carbuncle involving a third of the right kidney; there was also a small abscess in the left kidney.

Case 24.—Reschske's[23] third patient, a young man of twenty-two, had had a left dry pleurisy and pains in the left upper quadrant fourteen days before. There had been no temperature elevation. His physician had made a diagnosis of subdiaphragmatic abscess. On admission to the hospital he had a temperature of 102. Physical examination revealed no signs of pleurisy, no masses, but a dull pain on

palpation in the left upper quadrant. The urine contained albumin and some white blood cells, and on culture Staphylococcus and B. coli were found. The white blood count was 13,000. A pre-operative diagnosis of abscess of the kidney was made, and twenty-one days after onset a carbuncle of the kidney was excised with drainage. Etiology: Staphylococcus aureus. The patient recovered.

Case 25.—Reschske's[23] fourth case was a man of fifty-four. Several weeks after having a carbuncle of the neck and left supra-orbital region, he experienced a pain in the right lumbar region on palpation of the right upper quadrant. Ten days later he developed pain in the right flank accompanied by a temperature of 101. Examination of urine gave negative findings, but later revealed red and white blood cells; culture findings were negative. The white blood count was 20,000. Pre-operative diagnosis: Abscess of right kidney. Twenty-one days after onset a carbuncle of the kidney was excised with drainage. The patient recovered.

Case 26.—Mathé[17] reports the case of a young man of twenty-three. Four weeks after a furuncle of the left side of the jaw and upper lip, he developed a dull, aching, intermittent pain in the right lumbar region accompanied by fever and frequency of urination. On physical examination a round, regular, tender mass which moved with respiration, could be palpated in the right upper quadrant. There was no spasm of the overlying muscles. The urine contained occasional white blood cells, and the two-hour phthalein test was 67 per cent. The red blood count was 3,664,000; white blood count 18,100; hemoglobin 60 per cent; urea 12, and non-protein-nitrogen 23.7. At cystoscopy moderate injection of the right ureteral orifice and trigone was observed. The bladder urine was clear, as was the right kidney urine, but the latter contained shreds and a few red and white blood cells. The specimens from the bladder and both kidneys grew Staphylococcus aureus on culture. X-ray showed an enlarged right kidney, and the pyelogram a narrow pelvis with blunting of the minor calices. Thirty days after onset, a nephrectomy was done, at which time a carbuncle of the upper pole of the kidney, 5 cm., in diameter, was found. The patient recovered.

Case 27.—Beer[2] reports the case of a boy of sixteen who developed a pain in his left chest with an irregular temperature of 98-104 for two weeks. There had been no previous infection. At physical examination slight tenderness was elcited over the left kidney region, which later disappeared. His urine contained albumin. He had a high white blood count, and his Widal test and blood culture gave negative findings. At cystoscopy the left ureter was observed to be blocked. The urine from the right ureter was normal. X-ray showed an enlarged left kidney. A pre-operative diagnosis of cortical infection of the left kidney was made, and forty-two days after onset a

nephrectomy was done. A large carbuncle was found. The patient recovered.

Case 28.—Beer's[2] second patient, a young man of twenty-four, nine months previously had been admitted to the hospital because of the sudden onset of pain in the left abdomen radiating to the back. This was accompanied by fever, chills, and sweats. Physical examination revealed only tenderness in the left lumbar region, and after four months he was discharged, apparently well, and remained so for the next four months. He then developed a sudden severe attack of pain in the left hypochondriac and left lumbar regions, with a temperature of 101. On second admission, at physical examination, tenderness was still present in the left lumbar region and the left kidney was palpable and felt enlarged. The urine contained albumin and a few red and white blood cells. The blood count was reported normal. Cystoscopy on both admissions revealed no abnormalities, and x-ray showed normal kidney outlines. A pre-operative diagnosis of tumor or perinephritic abscess was made, and nine months after the first attack of pain a nephrectomy was done. At operation a carbuncle in the upper third of the kidney was found. Etiology: Staphylococcus aureus. The end-result in this case was not stated.

Case 29.—Beer's[2] third patient, a boy of ten, during the two previous years, had had recurring attacks of pain in the right flank and right upper quadrant, following alveolar abscess and tooth extraction. These attacks were diagnosed as abdominal lymphadenitis. Between attacks he was afebrile and apparently well, attending school regularly. One year later following a crop of furuncles, his symptoms became more severe and he developed a tumor mass in the region of the right kidney, at which time a diagnosis of tumor or tuberculosis was made. On admission to the hospital the urine was reported clear and blood chemistry normal. Cystoscopy showed nothing abnormal. The urine from the right kidney contained occasional white blood cells, many red blood cells, and was sterile on culture. X-rays revealed an enlarged right kidney, pyelogram normal. A pre-operative diagnosis of abscess of the cortex of the kidney was made and about two years after the first attack of pain, and one year after the appearance of the mass in the right kidney region, a nephrectomy was done. At operation a carbuncle involving three-quarters of the kidney was found, and Staphylococcus aureus was identified on culture. The patient recovered without postoperative complications.

Case 30.—Smirow[26] reports the case of a man of fifty-four who developed a carbuncle of the back six months before admission to the hospital. A month later he had paralysis of both legs and experienced a sharp pain in the left lumbar region and the left side of the abdomen. After the first day the pain was dull for some time, but later became severe again. (The carbuncle healed, having persisted during three

months of the present illness.) On admission physical examination revealed tenderness on palpation in the left kidney region and bulging in the left lumbar region. No mass was palpable. The urine contained albumin, ten to twelve red blood cells, three to five white blood cells, and one to two casts per high power field. In the renal function test, indigo-carmin appeared from the right kidney after nine minutes, but did not appear from the left in the same length of time. The urine from the right kidney contained many white blood cells, a great many red blood cells, and a few casts; that from the left kidney, albumin, a great many red blood cells, and a few white blood cells and casts. A pre-operative diagnosis of carbuncle of the kidney was made, and five months after onset a nephrectomy was done, which confirmed the diagnosis. The patient did not survive.

Case 31.—Smirow's[26] second patient was a woman of thirty-six, who fell and struck her back. She experienced no marked discomfort at the time. A few days later she developed a pain in the right lumbar region accompanied by general weakness. On physical examination a large tumor was found in the right kidney region; tender to palpation and movable with respiration. The urine contained albumin, many white blood cells, and a few red blood cells. At cystoscopy the indigo-carmin was delayed in appearing from the right kidney. The urine from the left kidney contained albumin and a few red and white blood cells. A pre-operative diagnosis of pyelonephritis and abscess of the right kidney was made, and about four weeks after onset a nephrectomy was done. At operation a carbuncle of the middle third of the kidney was found. Etiology: Staphylococcus aureus. The patient recovered.

Case 32.—Smirow's[26] third patient, a man of nineteen, had rhinitis and a moderate cough six weeks before admission to the hospital. He subsequently developed pain in the upper left back accompanied by a temperature of 101, chills, and sweats. The pain in the back persisted and radiated to the right pelvic region. There was no dysuria. The cough improved but later recurred with increased pain in the left back. A diagnosis of pneumonia and left pleural effusion was made. On admission to the hospital he was emaciated and feverish. On physical examination the heart and lungs were negative. The left upper quadrant was prominent. Palpation of the left costovertebral angle caused pain. The left kidney was palpable and felt enlarged, was tender to palpation, and did not move with respiration. The urine contained some white blood cells. At cystoscopy the bladder was found to be normal. Indigo-carmin appeared from the right kidney in thirteen minutes and from the left in thirty minutes. A pre-operative diagnosis of carbuncle of the left kidney and perinephritis was made. About four weeks after onset a nephrectomy was done. A carbuncle of the upper half of the kidney was found. The patient recovered.

Case 33.—Smirow's[26] fourth patient, a girl of fourteen, developed a redness all over her body one week after having experienced a pain in her left side accompanied by chills. There was dullness and increased fremitus in the lower right lung and a diagnosis of grippe with pneumonia and pleurisy was made. Twelve days after the onset of her chest symptoms she developed pain in the right costo-vertebral angle. On physical examination the right kidney was palpable and very tender. The urine contained some red and white blood cells. The white blood count was 11,200 to 14,400. Blood culture showed Frankel's diplococcus. X-ray of the lungs revealed a high right diaphragm with free respiratory motion and a clear right lung field. A pre-operative diagnosis of abscess of the upper right kidney and perinephritis was made, and ten days after onset a nephrectomy was done. The upper half of the kidney was found to be destroyed by a carbuncle. Etiology: Staphylococcus aureus. The patient recovered.

Case 34.—Smirow's[26] fifth patient, a woman of thirty-seven, two weeks after an attack of grippe developed a pain in the right lumbar region. The diagnosis was pyelonephritis. Upon admittance to the hospital the right kidney was found to be tender, hard to palpation, and movable with respiration. The urine contained albumin and on culture showed Gram-positive cocci. At cystoscopy the indigo-carmin was delayed five minutes in appearing from the right kidney. The urine from the right side contained some white blood cells, while that from the left was normal. A pre-operative diagnosis of abscess of the right kidney was made and a nephrectomy was done. A carbuncle involved the posterior half of the upper third of the kidney. Etiology: Staphylococcus aureus. The patient recovered.

Case 35.—Smirow[26] later reports the case of a man of forty-two, who for the past three years had had recurring attacks of pain in the right lumbar region. Attacks lasted one to two days at a time. Within the past year he had had furunculosis. He had been hospitalized for two months, during which time he developed chills and fever and pain in the right lower quadrant and right lumbar region. On physical examination dullness and diminshed breath sounds were heard at the right base and right thoracentesis yielded 12 c.c. of serous fluid. Tenderness of the right kidney and in the costovertebral angle was elicited on palpation. Temperature was 100.4. Urine contained albumin and 12 white blood cells per high power field. The red blood count was 3,640,000; white blood count 10,400; hemoglobin 65 per cent. Cystoscopy revealed a normal bladder. Indigo-carmin appeared on the left side weakly in eight minutes, and well in ten minutes; on the right, weakly in fifteen minutes. A pre-operative diagnosis of carbuncle of the right kidney and pyelonephritis was made, and thirty-one days after onset a nephrectomy was done. A carbuncle was found which involved the middle and lower thirds of the kidney. Etiology: Staphylococcus aureus. The end-result was not stated.

Case 36.—Shapiro[25] reports the case of a man of thirty-six, who, without previous infection, developed a steady dull pain in the right lumbar region which radiated to the scapula. He had a cutting pain at the beginning of urination and voided every two or three hours during the day and four times at night. He reported cloudy urine and some hematuria. On physical examination he was found to have a temperature of 100 and pain on pressure over the twelfth rib. The urine contained many white blood cells, and gross blood. White blood count 9,000. In the kidney function test indigo-carmin appeared from the left side in four minutes and from the right in fifteen minutes. The urine from both kidneys was normal. X-ray of kidneys was reported negative. About six weeks after onset a nephrectomy was done, at which time a carbuncle 4 cm. in diameter in the upper third of the kidney was found. Etiology: Staphylococcus aureus. The patient recovered.

Case 37.—Thompson[27] reports the case of a woman of fifty-two, who had a carbuncle of the neck which was incised and healed. Two months later she fell, striking the lumbar region of the back. Ten days after the fall she developed pain in the left side, malaise, and a temperature of 101. Diagnosis: Influenza. On admission to the hospital physical examination revealed tenderness and spasm of the muscles over the left kidney region, and swelling in the left loin which rapidly increased in size. The urine was reported normal. X-ray showed the right kidney to be normal and the left renal shadow ill defined. Twenty-eight days after onset a nephrectomy was done. A carbuncle of the lower third of the kidney was found. Etiology: Staphylococcus aureus. The patient recovered.

Case 38.—Voss'[28] first patient was a man of thirty-seven. Without any known previous infection he developed a fever, malaise, and pain in the left back about a month previous to admission to the hospital. On physical examination the chest was negative except for limited expansion on the left; rapid pulse; temperature 100; abdomen negative. A palpable mass was found in the left lumbar region and considerable tenderness was elicited on deep palpation over the left kidney. The urine contained albumin and many white blood cells. At cystoscopy the bladder was found to be normal. The test of kidney function resulted in a good flow from the right side after six minutes, but no flow from the left at the end of ten minutes. The urine from the left kidney was found to contain albumin only. An x-ray film was reported negative for renal stones. Pre-operative diagnosis: Perinephritic abscess and carbuncle of the left kidney. Thirty-five days after onset a nephrectomy was done. A carbuncle was found which involved the whole left kidney. There was also a perirenal abscess. The patient recovered.

Case 39.—Voss'[28] second case, a man of forty-eight, entered the hospital two months after having a carbuncle on the neck, and six

weeks after an infarct of the left lung. His chief complaint was an occasional pain under the left scapula. His general condition was poor. Heart was found to be enlarged to the left; abdomen normal; left kidney very tender to palpation; temperature 101.2; sputum bloody. The urine contained albumin and blood culture was positive for staphylococcus. At cystoscopy the left half of the bladder was observed to be slightly inflamed and pus was seen to flow from the left ureteral orifice. In the function test indigo-carmin appeared from the right kidney in five minutes, but no dye appeared on the left side. The left kidney was washed out with silver nitrate solution without improvement of the patient's condition. Pre-operative diagnosis: Septic pyemia, carbuncle and abscess of left kidney. Five days after admission a nephrectomy was done. A carbuncle involved the entire kidney. Etiology: Staphylococcus aureus. The patient recovered.

Case 40.—Dick[6] reports the case of a young man of twenty-three who entered the hospital complaining of intermittent pain in the right loin for one month. Later the pain became more severe and more frequent and finally became continuous. Slight relief was obtained by drawing up the right thigh. He also complained of recent frequency of urination and dysuria, nausea, vomiting, chills and fever. On physical examination a swelling was found in the right loin which moved with respiration and was very tender to palpation. The urine contained a few white blood cells. The white blood count was 12,000. At cystoscopy the urine from the right ureter was sterile. Pyelogram showed marked changes in the major and minor calices. Forty-two days after onset, a nephrectomy was done, at which time a carbuncle was found which involved the middle third of the kidney. The patient recovered.

Case 41.—Dick's[6] second patient was a boy of seventeen. Without any known previous infection he developed malaise three weeks before admission to the hospital, and two weeks later developed an acute pain below the left lower ribs. This was greatly aggravated by moving and pressure. He had frequency of urination. Physical examination showed tenderness to palpation in the region of the left kidney and in the left iliac fossa. Temperature was 102.5. Two days before operation the urine contained a few red and white blood cells. Forty-two days after onset a nephrectomy was done. A carbuncle was found which involved one-third of the kidney. The patient recovered.

Case 42.—Dick's[6] third patient, a woman of forty-eight, without previous infection developed severe frontal headaches and malaise, accompanied by obstinate constipation and a chilly feeling in the evening, two months before admission to the hospital. One month later she had a constant aching in the right side at the costal margin and attacks of severe stabbing pain which was aggravated by moving.

She also developed a cough and frequent urination. On admission there was tenderness over the left lower ribs, and breath sounds were faint at the left base. The temperature was 99 and the pulse 100. The urine contained a few white blood cells and on culture showed Staphylococcus aureus. A pre-operative diagnosis of pyonephrosis was made, and seventy days after onset a nephrectomy was done. A carbuncle was found which involved the upper third of the kidney. Etiology: Staphylococcus aureus. The patient recovered.

Case 43.—Kohler[10] reports the case of a man who entered the hospital complaining of pain in the left lumbar region, of three weeks' duration. On physical examination a tumor, which was very tender to palpation, was found in the left kidney region. The urine contained many white blood cells. At cystoscopy the result of the kidney function test was the same on both sides. A pyelogram revealed no abnormalities. A nephrectomy was done. A carbuncle was found which involved the lower half of the kidney. The patient recovered.

Case 44.—Lazarus'[13] first patient was a woman of thirty-four. An abscess of the labia majora had been incised and drained eleven weeks before admission to the hospital. Four weeks later she developed pain in the right upper quadrant and right lumbar region, accompanied by fever and vomiting. A diagnosis of acute appendicitis was made and an appendectomy was performed the following week. The pain in the right lumbar region was unrelieved by operation; the patient complained of urinary frequency. On physical examination an exquisitely tender area of induration was observed in the right flank which was slightly reddened and the overlying muscles were rigid. There was a palpable mass in the right kidney region. The temperature was 99.4 and the urine contained a good deal of albumin. At cystoscopy the urine from the right kidney contained occasional red blood cells; that from the left kidney was normal. The phthalein test was normal for both kidneys. X-ray showed the right kidney to be much enlarged and the line of the right psoas muscle was obliterated. Right pyelogram showed a partially filled pelvis with marked distortion of the minor calices. Forty-two days after onset the right kidney was incised, drained, and irrigated with Dakin's solution. At operation a perinephritic abscess and a carbuncle 2 cm. in diameter in the posterior side of the upper pole of the kidney were found. The patient recovered.

Case 45.—Lazarus'[13] second patient, a woman of forty-nine, had a carbuncle of the neck one year previous to admission to the hospital. Following this she had a carbuncle of the right arm which healed after incision and drainage, but she continued to run a febrile course and on admission complained of chills, fever, pain in the right lumbar region, nausea and weakness. Physical examination

showed tenderness and spasm of the muscles in the right upper quadrant, most marked at a point opposite the umbilicus. Temperature 101. The urine from the right kidney contained occasional red blood cells; urine from the left kidney was normal. X-ray showed a much enlarged right kidney and the right pyelogram demonstrated a small pelvis with clubbing of all minor calices. There was a sharp kink in the ureter opposite the transverse process of the fourth lumbar vertebra. About thirty-five days after onset, the kidney was incised and drained and dakinized every three hours. At operation a carbuncle 2.5 cm. in diameter was found in the posterior portion of the kidney. The patient recovered.

Case 46.—Lilienthal[14] reports the case of a woman admitted to the hospital with a history of a carbuncle, three months before, on the right buttock and who, six weeks later, developed pain in the left loin, malaise, and a temperature of 101. Tenderness in the left loin and left costovertebral angle were found on physical examination. The left loin was observed to bulge slightly. The urine was reported normal, as were also the cystoscopic and x-ray examinations. Pre-operative diagnosis: Abscess in the cortex of the kidney. Operation: Incision and enucleation of a carbuncle of the upper third of the kidney with drainage. The patient recovered.

Case 47.—Neff's[20] first patient, a man of twenty-four, six months after having furunculosis, developed a temperature of 103 to 106 with abdominal pain and malaise. After six days he was admitted to the hospital; a diagnosis of possible typhoid was made because of lack of "significant physical signs." Later he developed localized discomfort in the right flank. Physical examination revealed tenderness on pressure below the right lower ribs, and a palpable, round mass in the right flank which moved with respiration. On admission the white blood count was 6,000, but a few weeks later it had risen to 17,000. Blood culture and Widal test gave negative findings. At cystoscopy the bladder was found to be normal and the urine from both kidneys was clear and free from pus. Kidney function tests showed an excretion of 16 per cent of dye on the right, and 12 per cent on the left, in thirty minutes. A right pyelogram was reported normal, but the right renal shadow was abnormally large. Pre-operative diagnosis: Renal abscess, perinephritic abscess, or both. Operation: Enucleation of a carbuncle, with drainage, thirty-five days after onset of illness. Etiology: Staphylococcus aureus. The patient recovered.

Case 48.—Neff's[20] second patient, a man of twenty-nine, without previous infection was seized with severe left renal colic. After twelve days he developed chills and fever, and later a severe Vincent's gingivitis, and a sternal periostitis which suppurated; still later an abscess in the prostate which was incised and drained, and another

abscess in the soft tissues of the left shoulder which also required incision and drainage; and finally induration in the left costo-vertebral angle and tenderness in the left flank. The urine was full of pus; the white blood count was 13,000; blood culture showed Staphylococcus aureus. At the first cystoscopy the bladder was reported normal. Urine from the left kidney was purulent and from the right clear. Cultures of both specimens showed Staphylococcus aureus. Kidney function tests gave an excretion of 8 per cent of the dye from the right side in fifteen minutes; no appearance of dye from the left in the same length of time. At a second cystoscopic examination a small stone was observed in the bladder. X-ray of the kidneys was reported negative. Pre-operative diagnosis: Pyelonephritis and perinephritic abscess. Operation: Forty days after onset, enucleation of a carbuncle with drainage was done with marked improvement in the patient's condition. Later, however, because of recurrent temperature, a nephrectomy was necessary; an extension of the carbuncle 5.5x3.5 cm. was found below the upper pole of the kidney. The patient had a postoperative pneumonia and died.

Case 49.—Moore's[19] first patient, a boy of eleven, without previous infection, developed intermittent pain in the right chest accompanied by elevation of temperature as high as 103 at times. After six months he was admitted to the hospital. His weight at this time was only 65 pounds, and he was so weak that he could not walk without assistance. Physical examination revealed nothing of importance except spasm and tenderness in the right kidney region on palpation. Culture of urine showed hemolytic Streptococcus. The white blood count was 11,000; hemoglobin 58 per cent. At cystoscopy the bladder was normal and the urine from both kidneys contained no pus and was sterile on culture. Plain x-ray films of the kidneys were negative. A right pyelogram revealed a large, soft, tissue shadow in the region of the lower pole, which displaced and narrowed the upper 3 cms. of the ureter. Six months after onset a carbuncle of the kidney was incised and drained. The patient recovered.

Case 50.—Moore's[19] second patient, a man of thirty-seven, without any previous infection, developed pain in the right side, abdominal gas, repeated chills, fever and sweats, and slight dysuria. He had lost 25 pounds in weight and was very weak. General physical examination revealed nothing abnormal. The urine contained white blood cells throughout the course of his illness. White blood count was 9,300. At cystoscopy the urine from the right kidney contained three white blood cells per high power field, and on kidney function test indigo-carmin appeared from the right side in three minutes, and from the left side in four minutes. A right pyelogram showed marked deformity of the renal pelvis, characterized by a filling defect and elongation and distortion of the calices, suggestive of a right renal neoplasm. Pre-operative diagnosis: Right renal neoplasm. Operation:

Fifty-six days after onset a nephrectomy was done and a carbuncle discovered. The patient recovered.

Case 51.—Moore's[19] third patient, a man of fifty-one, scratched and infected the toes of his right foot. This infection was severe enough to cause him to be out of work for five weeks. Several weeks later he developed an abscess of the nose, and another of the skin of the wrist. Later he complained of weakness, anorexia, and intermittent fever of three months' duration. On physical examination upon admission to the hospital, slight bulging was noted in the region of the right kidney. Later there was definite tenderness in the right kidney region, and the kidney could be palpated. The urine contained occasional red blood cells and six white blood cells per high power field. White blood count was 22,700 and later rose to 31,900. Culture showed Staphylococcus twice, and was sterile on three other cultures, Cystoscopy revealed a normal bladder; right kidney urine contained an occasional pus cell. A right pyelogram showed an indefinite outline due to under-filling, and four days later on repetition there was a suggestion of the medium in the cortex of the lower pole. Preoperative diagnosis: Diseased right kidney. Operation: Three months after onset a nephrectomy was performed. The kidney was much enlarged and a carbuncle involved half of its area. The patient developed pneumonia and a duodenal fistula, and died fourteen days postoperative.

Case 52.—Moore's[19] fourth patient, a woman of thirty-three, six weeks after a furuncle on the neck, and three weeks postpartum, developed pain and tenderness in the right flank accompanied by chills, fever, and frequent urination. On physical examination there was tenderness in the right kidney region anteriorly and posteriorly. The urine contained much pus and a few red blood cells. White blood count ranged from 14,200 to 16,525. At cystoscopy 150 c.c. of residual urine containing much pus was found in the bladder, and 30 c.c. of retained urine in the right renal pelvis. In the kidney function test, 10 per cent excretion of dye appeared from the right, and 14 per cent from the left in fifteen minutes. On culture the urine from the right kidney showed B. coli; culture of urine from the left kidney was sterile. A right pyelogram showed a moderate degree of pyelectasis with no apparent distortion of the calices. A diagnosis of hydronephrosis with infection, moderate cystocele with residual urine, and acute cystitis was made. Treatment consisted of a right indwelling catheter left in place for thirty-six to seventy-two hours, and the patient was given mercurochrome-220 soluble intravenously, on two occasions. The chills and fever continued and three and one-half months after onset a nephrectomy was done. At operation the kidney was found to be smaller than normal and to contain a carbuncle 3 cm., in diameter, in the central portion of the convex border. The patient recovered.

Case 53.—Moore's[19] fifth patient, a woman of forty, five weeks after having an abscess of the left elbow and another over the left mastoid region incised and drained, developed a constant elevation of temperature (to 101) and later a pain in the right loin associated with frequency of urination. On physical examination the right kidney was observed to be slightly enlarged at the lower pole and tender to palpation. The urine contained much pus. On culture the blood yielded Staphylococcus aureus. Cystoscopy revealed cystitis. The urine from the right kidney contained pus and grew Staphylococcus aureus on culture, while that from the left was normal. A right pyelogram showed a definite narrowing and elongation of the lower calix. A diagnosis of metastatic infection, probably carbuncle of the right kidney, was made four weeks after onset, and the patient was treated with 20 c.c. of 1 per cent mercurochrome intravenously. Improvement was rapid and seventeen days after the institution of treatment the pyelogram was normal. The patient recovered completely without surgery.

Case 54.—Mark[16] reports the case of a little girl of nine months, who had a temperature of 102 of unknown origin, for two days prior to hospital admission. Twelve days later she cried with pain and the temperature was 103. Urine was negative for pus and blood, and a diagnosis of acute throat infection was made. For a week she ran an irregular febrile course and had one or two chills daily. By this time the urine contained pus in clumps, bacilli and staphylococci, and there was tenderness in the left costovertebral region. On entering the hospital her temperature was 105.6, and the pulse 130. She was well developed and nourished, slightly cyanotic and almost stuporous, with a slight suggestion of status lymphaticus. Slight tenderness and a little rigidity were observed in the left flank. The urine contained a trace of albumin and ten to twenty white blood cells. The red blood count was 2,710,000, and the white blood count 22,450; hemoglobin 54 per cent. On culture the urine showed B. coli. At cystoscopy the bladder was found to be normal. The urine from the right kidney contained no pus or blood, but that from the left contained five to six red blood cells, and grew a profuse B. coli on culture. Pyelogram revealed nothing abnormal. Although running some elevation of temperature she was taken home for five days. On re-admission a tender mass was palpable in the left kidney region, and a pre-operative diagnosis of surgical kidney was made. Twenty-eight days after onset, a nephrectomy was done, at which time a carbuncle of the upper pole of the left kidney was found. The patient made an uneventful recovery, and left the hospital ten days after operation.

Case 55.—Brady[3] reports the case of a young woman of eighteen, who developed a very severe coryza and sore throat one month previous to admission to the hospital. Two weeks later she experienced an extremely severe pain in the left flank radiating to the left lower quadrant and accompanied by nausea. On admission her temperature

was 101.4, and her pulse 120. A slight but definite tenderness was observed in the left kidney region. Six days later a mass was palpable at the same site. The urine was negative and the white blood count varied from 16,000 to 9,000. In the kidney function test phenolsulphonephthalein appeared on the right side in seven minutes, with an excretion of 45 per cent in the first half hour. On the left the dye appeared in thirty minutes and there was a 15 per cent excretion in the next half hour. A left pyelogram revealed the upper calix to be unusually long and the middle calix to have a filling defect, suggestive of a kidney tumor. A pre-operative diagnosis of perinephritic abscess or some lesion of the kidney was made, and three weeks after onset the kidney was incised and drained. At operation a carbuncle with raised, indurated border and depressed crater was found on the anterior surface of the kidney extending from a little above the midpoint down almost to the lower pole. Etiology: Staphylococcus aureus. The incision was washed daily with normal salt solution and 10 c.c. of Staphylococcus bacteriophage. The patient had an uncomplicated recovery.

Case 56.—MacMyn's[15] first patient, a girl of fifteen, developed pain in the right loin and a temperature of 102 about ten days after having a carbuncle of the buttock. An exploratory laparotomy was done, at which time a normal appendix was removed and about 3 ounces of fluid obtained which on culture showed Streptococci. Three weeks later there was pain in the renal area, both back and front. On physical examination at admission, tenderness of the right kidney was observed on deep palpation, and also some tenderness of the lumbar muscle. The urine was sterile and white blood count was 13,800. An x-ray revealed slight enlargement of the right kidney. A pre-operative diagnosis of infarct of the upper pole of the right kidney was made, and one month after onset a nephrectomy was done. A carbuncle was found in the upper pole of the kidney. Etiology: Staphylococcus aureus. The patient recovered.

Case 57.—MacMyn's second patient, a young man of twenty-two, without any known previous infection developed a diarrhea three months previous to admission to the hospital. The diarrhea was accompanied by the gradual onset of pain in the right side of the abdomen, anorexia, weakness, and occasional nausea. After admission he developed severe vomiting, which was controlled to a great extent by adrenalin. Physical examination revealed slight tenderness in the right lumbar region. The urine contained albumin and pus. The red blood count was 1,960,000; white blood count 11,200; hemoglobin 28 per cent; blood urea 46. At cystoscopy the bladder was observed to be normal. A few drops of purulent fluid were obtained from the right ureter; culture showed Staphylococcus aureus. Urine from the left ureter was sterile. On kidney function test there was a well colored efflux from the left kidney, but no dye appeared from the right side.

The pyelogram showed a normal left kidney and apparently complete absence of filling of the pelvis and calices of the right kidney. Operation was decided upon, but had to be postponed for two weeks on account of a severe reaction with rigors which was caused by a preoperative transfusion. Four months after onset, the right kidney was explored and a perinephritic abscess was incised and drained. The patient had a stormy postoperative course and died one month later. At autopsy it was found that the upper pole of the right kidney was almost entirely replaced by a carbuncle. There were many small abscess cavities scattered throughout; the culture of pus obtained showed Staphylococcus aureus.

Case 58.—Campbell's[4] first patient, a female infant of eight weeks, had had furunculosis of the chest and back five weeks previous to hospital admission. Two weeks later she developed a mass in the left flank, and obstipation. On admission she was markedly emaciated and anemic. The abdomen was distended and bulged on the left side due to a large, oval, firm, fixed, smooth-surfaced mass which filled the entire left loin. On rectal examination the mass was felt high in the left lower quadrant. The urine contained a trace of albumin and acetone, one to two white blood cells, and on culture showed Staphylococcus albus. Cystoscopy revealed a mild cystitis and trigonitis. On kidney function indigocarmin appeared in deep concentration from both sides in five minutes. The urine from the left ureter contained an occasional white blood cell and Staphylococcus aureus on culture. The urine from the right side was normal. A left pyelogram showed a normal pelvis with mesial displacement. A pre-operative diagnosis of perinephritic abscess was made, and forty-three days after onset a perinephritic abscess was incised and drained. Culture showed Staphylococcus albus and B. coli. Four days later nephrectomy was found necessary, and a typical carbuncle of the upper outer pole was revealed. The patient had a marked vasomotor collapse following operation, developed extreme abdominal distention and died six days after the nephrectomy.

Case 59.—Campbell's[4] second patient, a male infant of eight weeks, was admitted to the hospital because he had vomited all feedings and had had a hard, distended abdomen for two weeks. Shortly before this he had had furunculosis of the back. The history of furunculosis, however, was not known until after operation. Physical examination revealed a protuberant abdomen with a well-rounded, slightly nodular, fixed mass in the right loin extending from the umbilicus to the back, and from the costal margin to the iliac crest. The temperature was 102.2 and a nasopharyngeal culture was positive for thrush. The urine contained a marked trace of albumin and acetone, and a few scattered white blood cells. On kidney function test no indigocarmin appeared from the right side in ten minutes. The specimen from the right ureter contained much pus and showed Staphylococcus albus on culture. The

pyelograms showed a normal left renal pelvis and an enlarged right pelvis with blunted calices. A pre-operative diagnosis of renal tumor was made, and twenty-two days after onset a right transperitoneal exposure with drainage of a perinephritic abscess was done. Six days later there was massive evisceration through the operative wound, which had become infected. Three days after this, yellow feces appeared in small amounts in the dressings; signs of peritonitis developed, and the patient finally died eleven days after operation, with bilateral bronchopneumonia. At autopsy a carbuncle was found which involved the cortex and medulla of the upper pole of the right kidney. Another abscess, 4 mm. in diameter, was observed in the lower half of the kidney near the medial surface.

Case 60.—O'Conor[21] reports the case of a young man of seventeen, who developed weakness, anorexia, weight loss, and pain in the left lumbar region, six weeks after having a large furuncle of the chest which was ruptured by trauma. These symptoms persisted for two weeks previous to admission to the hospital, and were accompanied by intermittent nausea and vomiting, and a temperature of 100-103. On admission his temperature was 102 and his pulse 90. Slight tenderness was observed in the left lumbar region. The urine contained a slight trace of albumin, an occasional hyalin cast, one to two pus cells, an occasional red blood cell, many triple phosphates, many Gram-negative bacilli, and a few Gram-positive diplococci. On kidney function test the dye appeared from the right side in three minutes, and from the left in twenty-one minutes. The urine from the right side was sterile and that from the left showed Staphylococcus on culture. X-ray revealed an enlarged left kidney shadow but no obliteration of the psoas muscle outline. Pyelogram revealed marked displacement of the renal pelvis and upper few centimeters of the ureter toward the midline. The inferior calix was elongated, and distorted in the region of what appeared to be an enlargement of the lower pole of the kidney. A pre-operative diagnosis of carbuncle of the kidney was made, and thirty-four days after onset a nephrectomy was done. At operation a carbuncle occupying the entire lower pole of the left kidney was found; the invading organism was the Staphylococcus. The patient recovered.

Case 61.—Mayo and Burnell[18] report the case of a girl of nine, who developed an "attack resembling influenza" with swollen painful ankles, vomiting and frequent urination, six months following a case of the measles. On admission to the hospital the physical examination was negative except for the edema of the ankles, but almost two months later there was marked tenderness and a question of an enlarged right kidney. The urine was negative on admission, but a month later contained pus and showed Staphylococcus on culture. The urine from the right kidney contained coliform organisms, and that from the left was clear. The pyelogram on the right side showed

the opaque medium to assume an indefinite shape to the outer side of one calix. A pre-operative diagnosis of perinephritic abscess was made, and sixty-four days after onset a perinephritic abscess was incised and drained. Ten days later a nephrectomy was done, and a carbuncle with five or six openings oozing pus was found near the upper pole of the kidney. At the lower pole there was a similar lesion that had not perforated. Etiology: Staphylococcus aureus. The patient recovered.

Case 62.—Patch and Reid's[22] first patient, a man of thirty-four, had six abscessed teeth extracted and two days later developed a Staphylococcus aureus infection of the prostate, which was drained twice. The fever continued. Eleven days later physical examination revealed a movable, round mass, about 8 cm. in diameter, in the right kidney region. The left kidney was slightly enlarged. There was no pain on either side, and no tenderness. The urine contained a few pus cells and the blood yielded Staphylococcus aureus on culture. The urine from the right kidney was very purulent and showed Staphylococcus aureus on culture. The urine from the left side contained only a few pus cells. A diagnosis of bilateral renal infection and right pyonephrosis was made and, fourteen days after the appearance of the mass in the right kidney region, the right kidney was explored and drained. At operation a large pus cavity with edematous parietes was found. The patient improved slightly following operation, but later developed an abscess of the left loin and then an abscess of the left knee, and finally died of asthenia fifty-eight days after drainage of the kidney. At autopsy bilateral carbuncles of the kidney were found, as well as bilateral perinephritic abscesses. There was also Staphylococcus aureus pyemia, carbuncle of the right lobe of the liver, multiple lung abscesses, and bilateral empyema.

Case 63.—Patch and Reid's[22] second patient, a man of forty-four, was in the hospital three months previous to the present admission with catarrhal jaundice. About five weeks later a nail scratch on his left shoulder became infected and required dressing for three weeks. About this time he developed pain in the right upper quadrant which radiated to the back and gradually increased in severity. On two occasions he had mild rigors and later developed cough and blood-streaked sputum. On physical examination at admission, an icteroid tint to the scleræ was noted, and cyanosis of the lips and nails. The abdomen was greatly distended and the spleen enlarged. There was tenderness on pressure in the right upper quadrant. The left shoulder wound was still discharging pus and there was another abscess near it which showed Staphylococcus aureus on culture. The temperature was 99 to 102. The urine contained bile and a few pus cells on first examination, but later contained albumin in all specimens, with pus on only one of four subsequent examinations. The blood showed Staphylococcus aureus on two occasions and the sputum con-

tained the same organism. On admission a tentative diagnosis of bronchopneumonia was made, and, later, infectious thrombosis of the portal vein was suggested. The patient's jaundice deepened, his abdominal distention increased, and he died eleven days after admission, without operation. At autopsy a diagnosis was made of Staphylococcus aureus pyemia, bilateral carbuncle of the kidney, bilateral perinephritic abscess, acute axillary abscess, abscesses of the lungs and bilateral empyema.

Case 64.—Patch and Reid's[22] third patient, a young man of seventeen, was seized with a sudden sharp pain in the right loin which radiated to the front of the abdomen. This developed one week after having furuncles of the neck. In the period of five days before admission to the hospital the pain had persisted as a dull ache and was accompanied by constipation. On physical examination at admission his temperature was 102, and his pulse 100; there was acute tenderness and resistance in the right lower quadrant and in the right loin. The urine contained a faint trace of albumin, and the white blood count was 13,500. A diagnosis of acute appendicitis was made and the abdomen was opened and a normal appendix removed. Thirty-six hours later the patient complained of pain and tenderness in the right loin, and examination found marked tenderness and some resistance of muscles in the right costovertebral angle. There later developed increased frequency of urination. At cystoscopy the flow of urine was slightly less free from the right kidney, but the specimen was normal on microscopic examination, and sterile on culture. The pyelogram revealed incomplete filling of the right lower, and slight displacement of the middle calix. A pre-operative diagnosis of renal carbuncle and perinephritic abscess was made, and thirteen days after onset the right kidney was incised and drained. At operation a carbuncle was found on the posterior aspect of the upper pole of the kidney. Etiology: Staphylococcus aureus. The patient recovered.

Case 65.—Patch and Reid's[22] fourth patient, a single woman of fifty-three, four months after having a carbuncle of the left temple, entered the hospital complaining of a "feeling as of a mass," in the right loin, loss of weight and strength, and increased thirst of almost eight weeks' duration. On physical examination tenderness was noted in the epigastrium, right upper quadrant, and right costovertebral angle, and resistance in the right abdomen where there was a question of an indefinite mass. The urine contained a faint trace of albumin and the white blood count was 25,000. Fifty-three days after onset, an exploratory laparotomy was done, at which time the abdomen was normal except for a "large, hard, lobulated mass" in the region of the right kidney. The appendix was removed and an incision made into the parietal peritoneum. The kidney felt hard and fibrosed. Postoperatively the patient ran a febrile course; the urine contained thirty to forty pus cells and there was marked tenderness in the costoverte-

bral angle. Cystoscopy revealed a normal bladder. The urine from the right ureter was pale and cloudy, and that from the left clear and normal. On kidney function test, the dye appeared on the left in four minutes, and on the right after thirteen minutes. Pyelogram showed a normal left kidney; the right lower calices only partly filled and apparently displaced upward "strongly suggestive of tumor." Twenty-four days after laparotomy, and seventy-seven days after onset, a right lumbar incision was made which revealed a carbuncle; this consisted of a hard, almost cartilaginous mass which was incised and drained. The patient recovered.

Case 66.—O'Conor[21] later reported the case of a young woman of twenty-three, who had paronychia of the right index finger which healed after incision and drainage, two weeks before the present illness. Five weeks previous to this admission she had been admitted to another hospital, having been suddenly seized with a severe pain in the left lumbar region, extending anteriorly along the costal margin. This attack of pain was followed by chills and a temperature of 104. During this period she had had constant pain in the left upper abdomen and back, daily intermittent fever, nausea and vomiting, recurrent chills, and frequent night sweats, and had lost 30 pounds in weight. On admission she was pale and weak, had a temperature of 103, pulse 120, and exhibited marked tenderness in the costovertebral angle. No mass was palpable and the kidney could not be felt on deep inspiration. The urine was normal. At cystoscopy the bladder was normal. Both ureters were catheterized to 30 cm., and the urines from both kidneys and the bladder were sterile on culture. Dye appeared from the right kidney in three minutes, and from the left in eight minutes. The x-ray showed a high, slightly enlarged left kidney. A left pyelogram revealed a normal left ureter and pelvis, and normal middle and inferior calices, but superior calix branches that were flattened and widely separated, giving the impression of pressure from above. A pre-operative diagnosis of carbuncle of the upper pole of the kidney was made, and forty-five days after onset a nephrectomy was done, and a carbuncle occupying the entire upper pole of the left kidney was found. Etiology: Staphylococcus aureus. The patient recovered.

Analysis of the sixty-six reported cases of renal carbuncle, together with the sixty-seventh case herein presented, reveals, as has been stated, that the disease in the kidney has followed in most instances a primary skin infection of Staphylococcus origin. Thus forty-two of the group had furuncles, carbuncles, or other superficial abscesses. The respiratory tract was the apparent primary focus in only four cases; two patients had histories of trauma in the region of a kidney, and one had had chronic pyelitis.

There were in the whole series forty-one males and twenty-five

females; in one instance the sex was not given. The incidence according to age is shown in Table I. The oldest patient was fifty-six years, and the youngest eight weeks. There were three cases in infants; two were eight weeks old and one nine months.

The time elapsing between the original superficial infection and the onset of the present illness varied from a few days to many months, the average being fifty-three days. The actual onset was marked usually by pain in the general region of the flank. This is recorded as the initial symptom in forty-six of the cases. That the pain is not definitely placed and well localized in this disease, however, is evidenced by the difficulty in diagnosis as shown by the fact that there was an average delay of sixty-one days before proper treatment was instituted, in forty-two cases in which the records were complete in this regard. In some, the symptoms and the first physical signs were such as to lead to preliminary diagnoses of pneumonia or pleurisy. In others there was generalized abdominal distress, and in two instances the gall bladder and the appendix were suspected as the site of disease.

TABLE I. SIXTY-SEVEN CASES OF CARBUNCLE OF THE KIDNEY
Age and Sex

Age	Male	Female	Total
0-12 months	1	2	3
1- 9 years	—	1	1
10-19 years	9	5	14
20-29 years	10	4	14
30-39 years	9	5	14
40-49 years	4	3	7
50-59 years	5	3	8
Age not noted	3	2	5
Total	41	25	66
Age and sex not noted			1
Grand total			67

Malaise with progressive prostration and fever often persisting for many weeks are associated with the pain in most of the cases. Chills are frequently reported, and signs of pleuritic irritation are not uncommon. The whole clinical picture, conspicuously vague, may closely simulate that of a blood stream infection. In fact, in our opinion, an underlying septicemia is probably often present. The obscurity of the lesion is well emphasized by the preliminary

diagnosis suggested in the sixty-seven cases under consideration. Some of these were: Typhoid fever, pleurisy, pneumonia, nephroptosis, prostatic obstruction, hydronephrosis, appendicitis, abdominal lymphadenitis, tumor, pyelonephritis, influenza, cholelithiasis, and septicemia.

This clinical confusion may be accounted for in part by the lack of urinary symptoms. Only two of the series were recorded as having the onset of illness marked by bladder disturbance. This fact seems striking in a renal infection, until one remembers that the carbuncle occupies a circumscribed area within the parenchyma of the kidney, and that it does not of necessity communicate directly with the urinary excretory passages.

An analysis of the physical signs in this group finds that, in practically every instance, there was tenderness in or near the region of the kidney. This was often accompanied by resistance to palpation in the overlying muscles and frequently by the presence of an actual mass in the flank. A definite bulging in the lumbar region may be found, also, but this, we feel, results usually from an extension of suppuration into the perirenal tissues.

Inflammatory changes extending through the diaphragm have often resulted in misleading signs in the chest on the affected side. For example, there may be a lessened respiratory excursion, tenderness over the lower ribs, dullness, increased fremitus, diminished breath sounds, or râles, and the patient may complain of pleuritic pain. It is recognized that these are phenomena which may occur with any extreme type of infection in or around the kidney.

The laboratory evidence has not, as a rule, played an important part in the difficult diagnosis of renal carbuncle, though, as one reviews the entire series of sixty-seven reported cases, forty-four patients are found to have had abnormal urine. Pus was reported in thirty-five cases, and microscopic blood in nineteen. The urine was normal in only sixteen cases. There is no record of glycosuria in any instance.

White blood counts were moderately elevated in twenty-four of twenty-six cases. Only eight blood cultures are recorded in the series. Of these, six were positive. A staphylococcus was found in five cases, and a Fränkel's diplococcus in one. Blood chemistry seems to have been disregarded except in a few of the most recent cases.

As might be expected from the number of cases in which the urine was abnormal, cystoscopy has been performed commonly in the study of these patients. In the whole series of sixty-seven, cystoscopic examinations were made in forty-four instances. The results in the main, however, were not conclusive. In six cases the study was entirely negative. Where positive signs of disease were found, upon the affected side, these signs were chiefly those of renal infection and diminished renal function as compared with the well kidney. Except in isolated instances nothing pathognomonic of renal carbuncle has been found in the x-ray and pyelographic studies. Roentgen evidence of kidney enlargement has been reported several times; in the whole group we find mention of fifteen abnormal pyelograms. These presented no constant characteristic distortion. The abnormality consisted usually in displacement or filling defect, such as might be found with tumors in general. In only one case, our own about to be described, was intravenous urography employed. This method may prove of value, when, as in our experience, the condition of the patient will not permit of safe cystoscopy. In view of the diminished function of the affected kidney which has been observed so often, however, it is not to be expected that satisfactory intravenous urograms always will be obtained.

With reference to the record of diagnosis and treatment in the cases of renal carbuncle, it is interesting to note that a correct preoperative diagnosis was made in only eleven cases. Sixty-three of the sixty-seven patients were operated upon either by incision and drainage, or nephrectomy, or enucleation of the carbuncle. There was no surgical treatment in four instances; three of these patients died. The fourth non-surgical patient (Case 53), reported by Moore, recovered following the intravenous administration of mercurochrome. A positive blood culture, Staphylococcus aureus, had been obtained in this case.

The operation of incision and drainage was carried out nineteen times in the series, with a resulting mortality rate of 31.5 per cent. Nephrectomy was performed thirty-nine times with seven deaths, a mortality of 17.9 per cent; in two cases the end-result was not given. In a few instances the removal of the kidney occurred in a second operation after a previous incision or enucleation of the carbuncle without relief. Removal of the carbuncle from the kidney

by enucleation was performed successfully in five cases, and all of these patients recovered.

The case history which aroused our interest in this subject is as follows:

Case 67.—An American telephone lineman, single, aged twenty-one, entered the hospital June 23, 1930, complaining of fever. Five weeks before, while at work, he had had an acute attack of pain in the epigastrium and left upper quadrant of the abdomen. He consulted a physician who told him that he had grippe and ordered him to bed, but he continued to work, in the rain, for the next three days. On the fourth day he felt exhausted and drove to his home, 100 miles away. There it was found that he had high fever, and he complained of great pain. He was given tablets for a "cold" and hot applications to the abdomen. A few days after returning home he suffered pain in the left lumbar region.

Until the time of hospital entry the fever continued, ranging from 100 to 104; pulse 90 to 100; respiration 20 to 24; leukocyte count 13,000 to 15,000. For the week prior to admission there were profuse night sweats. The patient had been seen by three physicians, but no definite diagnosis had been made. The possibility of perinephritic abscess was suggested.

The past health was reported to have been good. There was an indefinite story of a possible infected finger (paronychia) within recent months.

Physical examination found a fairly developed, poorly nourished young man lying in bed and presenting the appearance of critical illness. Temperature 99.8; pulse 100; respirations 20. He had just reached the hospital after a journey of 100 miles. He was so excited and hypersensitive that it was difficult to evaluate his physical signs. The face was thin and flushed and showed a slight acneform eruption. There was profuse perspiration and the general appearance of a marked loss of weight.

Head examination revealed nothing abnormal; reflexes were normal; there was no edema and no enlarged glands. Chest expansion was fair, the excursion of the right side being greater than the left; on percussion there was dullness in the left lower axilla, and posteriorly below the angle of the scapula; breath sounds were greatly diminished and there were occasional crackling râles at the left base. The left border of the heart was 9 cm., from the midsternal line; right border 1 cm.; aortic dullness was 4 cm. The sounds were regular and of good quality; there was a loud ringing systolic murmur in the fourth interspace, heard loudest 4 cm. from the parasternal line. *A-2* equalled *P-2*. Systolic blood-pressure was 118; diastolic 60.

The abdomen was flat and tympanitic. There was generalized tenderness without spasm, and suggestion of peritoneal irritation, also

generalized, as shown by pain when the pressure of the fingers was suddenly released. The liver edge, spleen, and kidneys were not palpable. There was slight left costovertebral tenderness, but neither fullness nor mass was present in this region. Some tenderness was found in the corresponding area on the right side, but this was much less marked. Rectal examination revealed no abnormalities.

Laboratory data: The urine was amber color; slightly turbid; reaction acid; specific gravity 1.008; there was no albumin or sugar. The sediment showed one to five white blood cells to the high power field; there were a few clumps of leukocytes. There were no casts or red blood cells. Blood: Hemoglobin 65 per cent; red cell count 3,816,000; white blood count 15,000; differential count, polymorphonuclears 86 per cent; mononuclears 14 per cent. The red blood corpuscles showed achromia. The blood Wassermann test, blood culture, and Widal test gave negative findings. The blood urea nitrogen was 17 mgs., and the total non-protein-nitrogen was 29 mgs. in 100 c.c. of blood. The stool was liquid; benzidine test findings were negative.

X-ray of the chest revealed a symmetrical thorax; the trachea was in the midline. The lung fields and costophrenic angles were clear. The left diaphragm was slightly higher than the right. Fluoroscopic examination showed that the excursion of the left diaphragm was much less than the right. Films with reference to the urinary organs were not satisfactory because of the marked distention of the large and small intestines with gas, which obscured the renal and ureteral fields. No shadows of stones were visible.

On June 26, three days after admission, operation was decided upon. In the interval there had been no material change in the patient's condition, except that his temperature was slightly higher. The most dependable and constant physical signs had been marked tenderness and muscle resistance posteriorly in the kidney region on the left side. No mass was palpable. The pre-operative diagnosis was perinephritic abscess, although the clinical picture was far from typical of this condition.

Operation was performed under gas-oxygen-ether anesthesia. A short lumbar incision was made below and parallel with the twefth rib on the left side. After opening the lumbar fascia there was distinct edema in the perirenal fat. In the region of the kidney there was a large, smooth, firm mass which reached from the diaphragm to the pelvis; it was adherent to the posterior body wall. The gross appearance was that of an inflammatory process with the possibility of tumor to be considered. In one softened area a small amount of pus was found, a specimen of which was taken for culture. The wound was closed with drainage, because it was felt that further dissection was unsafe.

The immediate reaction to operation was good, and for a few days the patient made improvement. Culture made at the time of operation revealed Staphylococcus aureus. After several days the patient's con-

dition again became unsatisfactory. He developed a cough and perspired profusely. The temperature and pulse rate showed an upward trend. The urine contained twenty to forty white blood cells to the high power field, and the leukocyte count was 22,000. Further x-ray studies of the renal areas were made without definite results. Cystoscopy was considered but abandoned because of the patient's poor condition. Further surgical treatment of the left kidney now seemed imperative.

Anesthesia used in the second operation was spinal novocaine and gas-oxygen. An incision was made in the left flank below and parallel with the twelfth rib and carried forward and upward on the anterior abdominal wall to afford ample exposure. The incision was not carried posteriorly into the old wound until toward the end of the operation in order to avoid unnecessary contamination. The peritoneum was opened at once and this permitted exploration of the mass from its medial aspect. The lower pole of the spleen was found to be adherent, but it was carefully freed without injury. No enlarged glands were found to suggest the presence of malignant disease. The sigmoid was then carefully deflected medially and a small amount of pus was found in the region of the vascular pedicle of the kidney. The peritoneum was carefully walled off with warm saline packs. The mass was freed easily on all sides, except at the upper pole, where it was very adherent under the diaphragm. The ureter was clamped and tied with chromic catgut; it was thickened but its gross appearance was not that of tuberculosis or new growth. The entire mass was removed after clamping the renal vessels and tying them with chromic catgut. The peritoneum was closed except in the region of the lower pole of the spleen, where there was insufficient peritoneum for satisfactory closure. The defect in this region was covered with rubber dam, against which gauze strips were packed. The wound was closed with stay sutures of silkworm gut. Five hundred c.c. of matched blood from the mother was given at once by the citrate method; the patient left the operating room in fair condition.

Pathologic Report: The kidney was very large, measuring 14x7.5 cm. On cross section there was disclosed two large, greenish yellow nodules, 5.5 cm. in diameter, rather sharply circumscribed, and leaving but a small amount of relatively normal kidney tissue at the lower pole. The cut surface had irregular, small, crater-like depressions. Sections of the nodules showed puriform softening which extended to the external surface; the capsule was thickened and adherent. The accompanying photograph shows the extent of the lesion (Fig. 1).

Microscopic Examination: The picture varies from large regions of coagulation necrosis in which shadows of glomeruli and tubules were seen, to complete abscess formation. In one section where destruction was incomplete, groups of large pale cells occurred which suggested the possibility of a hypernephroma. Further sections

through this area were taken, but no definite tumor tissue could be found. There was a marked fibroblastic thickening of the renal capsule with lymphoid, plasma, and polynuclear cell infiltration. Cultures from kidney showed Staphylococcus pyogenes aureus. Diagnosis: Pyelonephritis with multiple abscesses, left.

Fig. 1. Author's case. Photograph of kidney removed. Normal renal parenchyma is shown at the lower pole. The nodular masses occupying the rest of the kidney are made up of discrete and coalescing abscesses (Leary Laboratory).

Final Clinical Diagnosis: Abscess, multilocular (carbuncle), of kidney, left.

After operation the patient made slow but satisfactory progress. He was discharged from the hospital on the forty-second postoperative day. During the early part of his convalescence he became afebrile for a time, but when he left the hospital his temperature had been ranging between 99 and 101 for a number of days. The pulse rate in spite of digitalis had remained rapid since operation; the rate was 100 at the time of discharge. The white blood count at this time was

6,000. He was transferred to his home by ambulance at the request of his family, who felt that he would gain more rapidly in home surroundings.

For a time there seemed to be definite improvement, but one month after leaving the hospital his physician reported that the patient had pain in the right axilla. Physical examination showed dullness in the right lower back and axilla with diminished breath sounds in this same area. The temperature was 102, respirations 20. The abdomen was negative and there was no costovertebral tenderness. The diagnosis at this time was bronchopneumonia.

About three weeks later it was reported that the patient was losing ground; there was still dullness on percussion over the right back and he had marked pain on slight movement. There was exquisite tenderness on pressure over the right lower axilla from the eighth to twelfth rib. The abdomen was soft and there was no costovertebral tenderness.

X-ray examination of the chest showed a distinct elevation of the right diaphragm with some clouding in the overlying lung. The diagnosis of subdiaphragmatic abscess was made. The patient was then returned, on October 15, 1930, to another metropolitan hospital, as it was considered that his problem was not urologic.

Operation was performed October 16, 1930, when a large perinephritic abscess was found which extended upward toward the diaphragm. The patient survived the operation, although he became progressively weaker in spite of two blood transfusions. He died on November 26, 1930.

The blood culture on November 9 was negative after seventy-two hours. The urine had shown a slight trace of albumin; a slight trace of sugar; much pus. At autopsy the right kidney was found to be completely destroyed except for a very small amount of renal parenchyma in the region of the lower pole. The renal pelvis had been practically obliterated and the abscess had invaded the liver. The ureter was moderately dilated except in the region of the bladder, where it was normal in size. There were signs of a Staphylococcus septicemia with pericarditis and infarcts of the lungs.

In conclusion, and after reviewing the cases reported in the literature, it is our feeling that the term "carbuncle" sometimes may be loosely applied, and that, in some instances, such as our own finally proved to be, the disease is not so much a localized lesion of the kidney as an actual pyemia, with multiple suppurative foci throughout the body. We believe that the term "carbuncle" is best reserved for the true multilocular abscess of a kidney in cases where it is at least possible, surgically, to effect a cure by drainage or removal of the renal lesion.

With reference to diagnosis, it is apparent, from the clinical confusion which has surrounded these cases of carbuncle of the kidney, that there is need for more accurate diagnosis of this condition so that earlier treatment may be instituted. We have found, as has been stated, that there was an average delay of sixty-two days in forty-two cases before proper therapy was begun. There is no doubt, however, that the diagnosis will always be difficult, and we doubt that it will ever be clinically possible with methods yet available to distinguish accurately between the true carbuncle, the solitary abscess, and suppurative pyelonephritis, or sometimes even perirenal abscess. However, one should be able, at least, to place the process within the renal fossa. It will be recalled, as was stated earlier, that some of the preliminary diagnoses in the sixty-seven cases under consideration were: Typhoid fever, pleurisy, pneumonia, nephroptosis, prostatic obstruction, hydronephrosis, appendicitis, abdominal lymphadenitis, tumor, pyelonephritis, influenza, cholelithiasis, and septicemia.

In endeavoring to arrive at the correct diagnosis in this obscure condition, the history and clinical course of the illness are of the first importance. Forty-two of the sixty-seven patients herein described had had some form of superficial pyogenic infection prior to the onset of the present illness. Such a history, therefore, in an individual suffering from long-continued fever of unknown origin, will suggest the possibility of suppuration in or about the kidney.

In spite of the fact that the correct diagnosis was made but seldom in this series, study of the physical signs finds that in almost every case there was tenderness in the renal region, often accompanied by resistance to palpation in the overlying muscles. The urine, moreover, was found to be abnormal in forty-four instances, and a moderate leukocytosis was the rule.

Blood culture should be made much more frequently under such circumstances, and should be repeated at frequent intervals, if negative, in every case. Only eight blood cultures were reported in this group, and of these, six were positive. In our patient (Case 67) this test was made three times with negative results, but the autopsy revealed the signs of a staphylococcus septicemia.

Cystoscopy has not been as helpful as might be expected. Cystoscopic examinations were performed in forty-four of the sixty-seven cases. As has been stated, where pathologic evidence was ob-

tained, the signs were usually those of infection upon the affected side and diminution of renal function as compared with the kidney on the opposite side. This depression of renal function is a sign of the greatest importance in this difficult differential diagnosis. The pyelogram may be abnormal in carbuncle of the kidney, but if so the distortion will not be typical and pathognomonic of this condition. There may be displacement of the kidney or compression of its pelvis, or filling defects such as may be produced by other more common processes. Intravenous urography in some instances may be of the greatest value when the patient's condition will not permit of more thorough urologic investigation, but the results of this method will not be uniformly dependable in all cases. If the disease in the kidneys has greatly depressed the function, one will not expect the intravenous dye to be excreted in sufficient concentration to afford a satisfactory film.

Last, and of the greatest importance in these cases, may be the x-ray and clinical evidence of fixation of the diaphragm on the affected side. Often, and particularly upon the left, when there is marked infection in or around the kidney, there occurs a direct extension of the inflammation through the diaphragm which results in its limitation or fixation, as well as in confusing signs and symptoms in the adjacent lung and pleura. Fluoroscopic examination as well as x-ray films of the chest should be made in the examination of these cases.

The treatment of renal carbuncle is surgical, and it is to be hoped that earlier and more accurate diagnoses of a suppurative process within the kidney will result in surgery more promptly. The choice of procedure will vary with the condition of the patient. There are three methods: (1) incision and drainage followed later if necessary by nephrectomy, (2) primary nephrectomy, and (3) enucleation of the carbuncle. The lowest mortality in this group of cases was obtained with the last-named operation. Enucleation of the carbuncle was reported in five instances, and all of these patients recovered. However, we feel that conditions favorable for this type of operation will be found infrequently. The next lowest mortality (17.9 per cent) followed nephrectomy, and this in general should be considered the treatment of choice. It may be stated further that the value of nephrectomy in two stages cannot be over-

emphasized for those patients who have become seriously depleted by their infection.

Finally, it is our feeling with reference to renal carbuncle that the really urgent consideration in this whole problem lies in a more prompt recognition of the clinical picture which may be presented by any of the obscure, deep-seated suppurative processes in and around the kidney, to the end that proper treatment may be administered more quickly.

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REFERENCES

1. Barth, A.: Ueber Nierenkarbunkel. Arch. f. klin. Chir., 94:477, 1920.
2. Beer, E.: Chronic carbuncle of the kidney and silent kidney infections. Internat. Jour. Med. and Surg., 37:219, 1924.
3. Brady, L. J.: Carbuncle of the kidney (metastatic Staphylococcus abscess of kidney cortex). Jour. Urol., 27:295-316, 1932.
4. Campbell, M. F.: Renal carbuncle in infancy. Jour. A. M. A., 98:1729, 1932.
5. Colmers, F.: Ueber Nierenkarbunkel im Auschluss an eine Beobachtung bei einem Kinde. Ztschr. f. urol. Chir., 14:235, 1923 and 1924.
6. Dick, B. M.: Staphylococcal suppurative nephritis (carbuncle of the kidney). Brit. Jour. Surg., 16:106-113, 1928.
7. Eisendrath, D. N.: Infection of the kidney. S. Clinic, Chicago. 4:1003-1022, (October) 1920.
8. Horn, W.: Ueber Nierenkarbunkel. Ztschr. f. urol. Chir., 14:1-5, 1923.
9. Israel, J.: Metastatischer Karbunkel der Niere. Deutsche med. Wchnschr., 1660-1661, 1905.
10. Kohler, H.: Ueber Nierenkarbunkel. Zentralbl. f. Chir., 56:1927-1930, 1929.
11. Klumow, E. V.: Ein Fall eines metastatischen hamätogenen Abscesses (Karbunkels) der Niere. Vestnik Khirurgie, 4:320-323, 1924.
12. Kretschmer, H. L.: Carbuncle of the kidney. Jour. Urol., 8:137-148, 1922.
13. Lazarus, J. A.: Two cases of carbuncle of the kidney. Jour. Urol., 21:353, 1929.
14. Lilienthal, H.: Carbuncle of left kidney; resection of upper third of kidney. Surg. Clin. North Amer., 10:457-460, June, 1930.
15. MacMyn, D. J.: Carbuncle of the kidney. Brit. Jour. Urol., 4:11, 1932.
16. Mark, E. G.: Carbuncle of the kidney. Urol. and Cutan. Rev., 36:93-94, 1932.
17. Mathé, C. P.: Carbuncle of the kidney. Calif. and West. Med., 22:6-1, 1924.
18. Mayo, H., and Burnell, G. H.: Carbuncle of the kidney. Australian and New Zealand Jour. Surg., 2:205, 1932.
19. Moore, T. D.: Renal carbuncle. Jour. A. M. A., 96:754-758, 1931.
20. Neff, J. H.: Ann. Surg., 93:506-610, 1931.
21. O'Conor, V. J.: Carbuncle of the left kidney. Surg. Clin. N. Amer., 12: 1259, 1932. Carbuncle of the kidney. Trans. Amer. Assoc. G. U. Surg., 25:17, 1932.
22. Patch, F. S., and Reid, R. G.: Carbuncle of the kidney with report of two cases of bilateral involvement. Trans. Amer. Assoc. G. U. Surg., 25:1, 1932.
23. Reschske, K.: Ueber Paranephritis und Nierenkarbunkel. Arch. f. klin. Chir., 129:303-327, 1924.
24. Riazanzeva, T. A.: Carbuncle of kidney. Vestnik Khirurgie. 3:149, 1923-1925.
25. Shapiro, E. N.: Carbuncle of kidney. Vestnik Khirurgie. 10:268-270, 1927.

26. SMIROW, A. W.: Ueber Nierenkarbunkel. Ztschr. f. urol. Chir., 20:243-256, 1927.
27. THOMPSON, T.: Carbuncle of the kidney. Lancet, 2:695-697, (October) 1927.
28. VOSS, R.: Ueber Nierenkarbunkel. Ztschr. f. urol., 21:101-112, 1927.
29. ZINN, W.: Therapie der Gegenw. 14:145-151, 1912.

DISCUSSION

DR. HENRY G. BUGBEE (New York City): I don't know just how large a hydronephrosis should be to qualify as a giant hydronephrosis, but I think that these two cases that I should like to cite come under that class. These cases are extremely interesting from the standpoint of diagnosis because the symptoms are those due to pressure; seldom do they present urinary symptoms.

(Slide) This patient was a girl of eighteen who had been under the observation of internists for several years. Her symptoms were gastro-intestinal. She never had any urinary symptoms. She had noticed a fullness in the left side of the abdomen, which, at times, was very pronounced. On cystoscopic examination there was marked pressure upon the bladder, the bladder being flattened as it would be by a pregnant uterus. Catheters passed to the kidneys easily, and the right kidney was normal according to a pyelogram, function, and urinalysis. On the left side there was a marked diminution of function. A small amount of diodrast was injected and we obtained this picture. We thought the patient had a moderate hydronephrosis, probably secondary to an anomalous vessel. At operation, much to my surprise, I encountered an enormous mass, which completely filled the left side of the abdomen, extended down into the pelvis, flattened the bladder and extended across the abdomen. The diodrast had made itself apparent only in the upper pole of this large hydronephrosis. This brings out a point in connection with pyelography in these cases, whereby one may easily be misled in interpreting the pyelogram that one obtains. Over three quarts of urine were present in this sac. This patient made an uneventful recovery.

(Slide) This man, who was forty-seven years of age, had an enormous tumor of the abdomen. He, also, had been under the observation of internists and was being treated for his gastro-intestinal symptoms, primarily due to atony of the intestine. No x-rays had been made by the internist up to that time and the first x-ray showed this calculus and these small shadows low down, which we interpreted as small calculi in a hydronephrotic sac.

(Slide) Injection showed this picture. A small amount of the

fluid accentuated these shadows, and we still thought we had a hydronephrotic sac, but we could not account for the size of the abdomen.

(Slide) Here we have a better idea of this sac. This is a barium injection of the colon, which gives a much better definition of the mass than do any of the pyelograms. In these cases, you undoubtedly will obtain more information from injecting the colon than you will from pyelograms. I cut down upon this mass and freed the sac before tapping it; then I tapped it and found seven and one-half quarts of urine in the hydronephrotic sac; the sac was then removed, and this patient, also, has made a satisfactory recovery. He still has attacks of abdominal distention which are due to atony of the bowel.

Dr. John R. Caulk (St. Louis, Mo.): I am tremendously interested in the subject which Dr. Howze so nicely presented. There are several problems, anatomic, physiologic and chemical, concerned in the creation and production of these giant hydronephroses. In the first place the majority result from congenital strictures at the uretero-pelvic juncture associated with an extrarenal pelvis. The enlargement taking place first at the expense of the pelvis, which may assume tremendous proportions without any encroachment really upon the secretory elements of the kidney. Finally, as the obstruction progresses, the tubular system begins to become destroyed first, which is very important in the creation of these sacs, for the simple reason that as the tubular system becomes interfered with out of proportion to the glomerular system, there is no reabsorption of fluids; therefore, the glomerular filtrate passes directly through to the pelvis and many of these hydronephrotic sacs have a decided increase of urinary output of fluids. There is also a diminution of the solid elements.

A little girl just recently observed brings out these points very strikingly. She was four years old. There was a tremendous left-sided tumor from which I removed 1,200 c.c. of infected fluid. Through the nephrostomy drainage tube I studied the urinary excretion. The excretion of fluids through that tube was six times the amount obtainable from the normal side. The solid constituents, particularly the nitrogenous elements, were just one-fifth of the normal kidney, and with all this fluid there were just patches, or islands, of secretory tissue capping the hydronephrotic sac.

Particularly, therefore, I think there are two points in the creation of these hydronephroses: the presence of a congenital type of hydronephrotic pelvis (the extrarenal pelvis) to allow this enlargement, and the fact that the tubular system is interfered with out of proportion to the glomerular; hence the lack of reabsorption and the increased amount of fluid exudate.

The other unfortunate circumstance about these hydronephroses is their tendency to bilaterality. The striking thing is that after the removal of the large sac, the one that is small often very suddenly undergoes a rapid dilatation, which signifies the necessity for close supervision of these patients who have had a remaining kidney which is slightly hydronephrotic. They should be watched carefully, and if necessary drained with a catheter and dilated. Yet they are not very susceptible to dilation and often require some type of plastic procedure to insure proper drainage.

Dr. Ira R. Sisk (Madison, Wis.): An interesting thing about these very large hydronephroses is the absence of pain; consequently, they are frequently seen by the gynecologist or the general surgeon because it is thought that the patient has an ovarian cyst or other intra-abdominal pathologic lesions. We have had two patients admitted to the service of gynecology with these large tumors which were thought to be ovarian cysts. The first patient was operated upon by the gynecologist, who encountered a retroperitoneal mass and aspirated 8,800 c.c. of urine in his bucket and said that most of it ran on the floor.

Soon after he dealt with that patient, another with a similar condition was admitted to his service, and having had this previous experience he asked that we see the patient and we found a very similar hydronephrosis (slide) which extended well across the median line and into the pelvis. (Slide) It was removed by nephrectomy.

On the first patient whom I mentioned, after the sac had drained for several weeks, a nephrectomy was done and the sac was fixed well down in the bony pelvis. It was removed with great difficulty.

Dr. J. H. Neff (University of Virginia, University, Virginia): I was particularly interested in Dr. Graves' report because my original presentation before this Society dealt with renal carbuncle. At that time I suggested the wisdom of enucleating car-

buncles when possible to the end of conserving renal tissue and because later therapeutic embarrassment would be avoided in those instances where abscesses or a carbuncle later develop in the opposite kidney.

I have seen one patient since that time in whom a diagnosis of carbuncle was made. This was a woman of fifty-odd years who had been sick three weeks when she came to operation. There was the usual picture of sepsis and local tenderness in the left flank. The phthalein output on this side was slightly diminished. The urine was free of pus and blood; no bacteria were shown by smear or culture. (Showing slides) In this slide you will notice the central filling defect and the strung-out appearance of the pelvis. The carbuncle was readily enucleated. In this second slide you see the carbuncle and the kidney from which it came. Nephrectomy had to be done because, after removing the carbuncle, there was a great amount of bleeding which I could not control. A careful study of this removed kidney revealed no other suppurative foci so that, had I been able to control the hemorrhage, removal of the carbuncle only would no doubt have succeeded in preserving a useful kidney.

Dr. George R. Livermore (Memphis, Tenn.): (Slide) I show this slide to emphasize and to bring out the point that Dr. Howze made about the lack of symptoms in his case. This is a bilateral giant hydronephrosis. The patient was about twenty-two or twenty-three years of age. She had completed her service in the hospital as a trained nurse, had just graduated and was on duty up to within a few days before this picture was taken. One of the men on the staff took her up to the cystoscopic room. She was in such bad condition he hoped to put a catheter in each kidney, drain and give some relief. Cystoscopy showed the ureteral orifices dilated to the size of the little finger; he removed the cystoscope, filled the bladder with pyelographic medium and elevated the foot of the table and had this picture made. The patient died two days later. Such cases prove that few symptoms may be present in some patients with marked kidney destruction.

Dr. Herman L. Kretschmer (Chicago, Ill.): Dr. Graves' paper interested me very much, and I think the place to spread the gospel about the early recognition of carbuncle of the kidney is

among the general practitioners who always see these patients first. In my experience the diagnosis is very simple and very easy by the time the patient enters the hospital because, as Dr. Graves brought out in his paper, the patient probably has been ill for a long time. I think the diagnosis is based upon two factors: first, and probably most important in the diagnosis, is the history of infection. If a careful history is elicited, one practically always obtains a history of an antecedent infection, such as a carbuncle, furuncle, paronychia, or osteomyelitis. In some cases the patient gives the history of an antecedent infection of the skin, and in some the infection of the skin is still present when the patient with carbuncle enters the hospital. The second important factor in the diagnosis is the history of a long-continued course of fever, the presence of a leukocytosis often associated with secondary anemia, and tenderness or swelling in the kidney area plus an enlarged palpable kidney that is generally fixed and not readily movable. The urine, as a rule, is negative.

As a general rule I do not believe that it is necessary to resort to special instrumental examination such as cystoscopy and ureteral catheterization. Pyelograms are important in giving additional information, but often, as Dr. Graves and others pointed out, they have filling defects that are compatible with tumor. Nevertheless, I think if there is one condition in the urinary tract that can be diagnosed over the long distance telephone from the history of the patient it is carbuncle of the kidney. Sometimes great difficulty is experienced in making a differential diagnosis between perirenal abscess, solitary abscess, and carbuncle, all of which, as a matter of fact, are also surgical conditions. I believe the point should be stressed that if the kidney is to be saved—and even the life of the patient in some cases—the patient should come to the hospital early in the course of the disease.

The question of bilaterality of this lesion has been emphasized and it is needless to say that this is an exceedingly important point. Many years ago I reported just such a case in which I removed a kidney and the patient was discharged from the hospital, only to come back four weeks later with a carbuncle on the other side. Bearing this in mind when I operated upon a little boy who developed a carbuncle I did a resection of the carbuncle. Three or four months later he developed multiple abscess of his other kidney

so that we felt very well satisfied that we had not removed his opposite kidney.

Therefore, in summing up this problem, I believe that this is one field in which we, as specialists, can and should educate the general practitioner to make the diagnosis early and, as I have already stated, I believe this to be a relatively simple matter.

DR. EDWARD L. KEYES (New York City): It seems to me that excision of a carbuncle (I dislike the name) of the kidney is based upon a supposed analogy to the carbuncle of the skin. The skin being a tough, dense, fibrous tissue and the kidney being a soft, pultaceous tissue, it has been my custom to drain the carbuncle in the kidney and never to excise it. I do not recollect that I have had any occasion to regret that action.

RESECTION OF LARGE SOLITARY RENAL CYSTS

DESCRIPTION OF A SATISFACTORY TECHNIC

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Clinical reports concerning large serous cysts of the kidney have been increasingly numerous in recent years. Although at autopsy[1] solitary cysts of varying size have been encountered in from 3 to 5 per cent of the kidneys carefully examined, the condition has been considered uncommon clinically.

It is not my purpose to review the literature of this subject, as it has been completely covered in several recent contributions. I merely wish to present for your consideration a technic of resection which has recently been employed in four patients with most satisfactory results.

Technic.—After thorough extraperitoneal mobilization of the kidney has been accomplished the pedicle is isolated and the vessels compressed by an assistant's thumb and forefinger. An incision encircling the base of the cyst is then carried through the renal capsule to the cortex. It is important to make this incision complete before enucleation of the cyst is begun, otherwise the edge of the capsule on the under surface of the cyst will be torn or a large portion of it may be stripped from the kidney. The capsule may then be freed for a short distance away from the cyst and will be easily kept intact for closure after the cyst has been removed. The cyst is then carefully enucleated along the proper line of cleavage. As the cyst is removed from the kidney substance the base should be inspected attentively to note any connection that may exist with a calix or the renal pelvis proper. Depending upon the location and size of the cyst, there is always a more or less extensive cone-shaped depression which must be obliterated after the removal of the cyst. A piece of internal oblique muscle corresponding with the anteroposterior length of the aperture in the renal tissue and about one-half inch wide, is sutured to the renal capsule at either end of the defect.

A band of ribbon gut (after the method suggested by Lowsley

and Bishop[2] for closure of nephrostomy wounds) is then threaded through six capsular flaps in such a manner as to bring the cut surfaces of the kidney in perfect approximation when the ribbons are tied. This forms a compressing sling in a somewhat figure-of-eight manner. The transplanted piece of muscle is retained beneath the capsule and between the raw surfaces of the renal tissue.

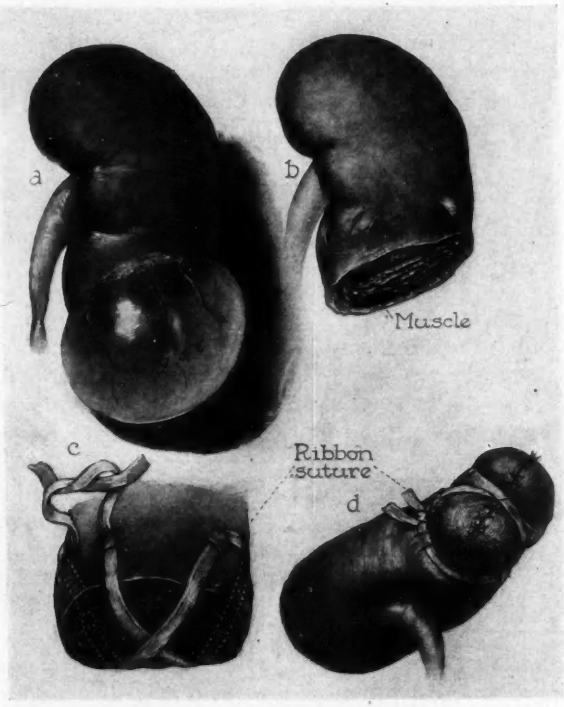

Fig. 1. Technic of resection of large solitary cyst of the lower pole of the kidney.

The capsular edges can now be approximated without strain or tension and pads of transplanted fat along this suture line are unnecessary. No sutures have been introduced into the renal parenchyma or cortex. Digital compression of the pedicle is then released.

In the four patients upon whom this procedure has been used absolute hemostasis has been immediate.

Comment.—In any resection of the renal tissue two technical considerations are important: Immediate and remote control of hemorrhage and prevention of urinary leakage through the resected area.

I have used the Lowsley ribbon gut sutures with great satisfaction in eight nephrostomies and two hemi-nephrectomies and have been surprised to find that this material has not come into more widespread employment by other urologists. In large gaping wounds of the kidney I prefer muscle to fat as a hemostatic pad, especially when closing sizable incisions in the renal parenchyma. Ockerblad has recently emphasized the efficiency and safety of muscle implants and has shown that there is no danger from later sloughing or separation because of their rapid incorporation with the adjacent tissues.

Quinby and Bright[3] described "solitary cyst of the kidney" as occurring in three varieties: first, the simple thin-walled cyst, containing a serous fluid, which bears no anatomic causal relation either to the pelvis or to a calix. Secondly, those cysts which, though they compress and push aside the secretory tissue of the kidney in the same way as does the first group, have a deeper origin and communicate with some portion of the renal pelvis by a minute channel. The third group, which is apparently rarely seen clinically, includes cysts which lie outside the kidney proper but do not represent a true hydronephrosis. Cases 1 and 2 of my group were of the first type, while Cases 3 and 4 were of the second type, although no pyelographic fluid appeared in the latter cysts. It is ordinarily recommended that suture of the calix or connecting channel be done after the cyst is removed. In these two instances muscle implanation and adequate compression of the renal surfaces as described prevented any subsequent urine leakage.

CASE REPORTS

Case 1.—The patient, a man fifty-eight years of age, referred by Dr. LeBoyd on June 5, 1934, had been removed from another hospital eight days before, where he had been suffering with chills and fever and left lumbar pain. A diagnosis of septicemia had been made al-

though the antecedent history was vague. Temperature range was from 99° to 104° F. daily with a polymorphonuclear leukocytosis varying from 18,000 to 26,000. Urinalysis showed a trace of albumin, no pus or blood, an occasional hyaline and granular cast. Culture showed no abnormalities.

Because of the persistent pain in the left lumbar and upper left

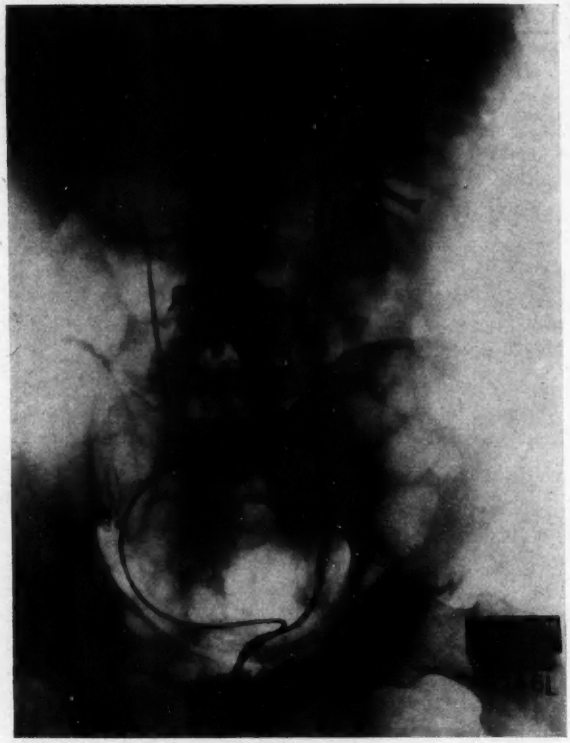

Fig. 2. Case 1. Diagnosis of the left perinephric abscess. Large solitary cyst of the lower pole was found at operation.

abdominal regions with tenderness on pressure, pathologic changes in the left kidney were suspected. Roentgenograms showed an enlarged left kidney shadow with obliteration of the psoas outline. No shadows suggested stone. Cystoscopy revealed a normal bladder and clear urine from either kidney. The dye output from the left kidney was somewhat delayed, but the quantitative output was normal. Left

pyelogram showed elongation and compression of the inferior and middle calices, suggesting external renal pressure or tumor formation. A diagnosis of perirenal abscess was made and the kidney exposed through a flank incision. No abscess was found. The lower pole of the kidney was occupied by a very large solitary cyst 4 inches in diameter. The cyst was resected as before described, the

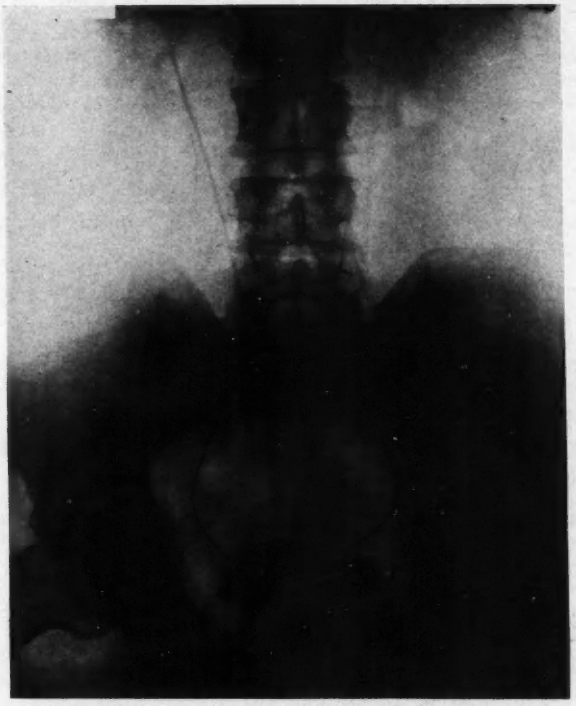

Fig. 3. Case 2. Diagnosis of left renal neoplasm. Large solitary cyst of the lower pole was found at operation.

kidney itself appearing normal. The wound healed completely in fourteen days and the pain previously noted was entirely relieved. The septic course and general malaise continued and positive blood cultures of Staphylococcus aureus were obtained three weeks after operation. Repeated blood transfusion and chemotherapy were of no avail, and the patient died thirty-six days after operation. Autopsy showed multiple abscesses in liver, spleen and brain. The kidneys had no

foci of infection and the lower pole of the left kidney was completely healed, with complete disappearance of all suture material; the latter in spite of the continued bloodstream infection.

Case 2.—Lawyer, male, aged fifty-seven years, was admitted January 3, 1935, complaining of an initial profuse, painless hematuria of twenty-four hours' duration. He had always been in excellent health and his past history was unimportant. Complete physical examination was negative. Neither kidney was palpable or tender and the prostate felt normal per rectum. Urine was port-wine in color and contained many small clots. Cultures gave negative findings. Blood count revealed hemoglobin 90 per cent, 5,250,000 erythrocytes, and 6,300 leukocytes. Differential was normal. Blood pressure was 112/60. Cystoscopy showed a normal bladder with bloody efflux from the left ureter. After catheterization, urine from the right kidney was normal; from the left, bloody. Phenolsulphonephthalein appeared in three minutes from the right and in five minutes from the left, and there was equal and excellent excretion from both in thirty minutes. Flat x-rays showed an enlarged left kidney shadow, no calculi. Left pyelogram showed complete obliteration of the inferior calix. Intravenous urograms on the following day confirmed this finding and showed normal right renal pelvis, calices and ureter. A diagnosis of left renal tumor, probably hypernephroma, was made. X-rays of the chest revealed no abnormalities.

Left lumbar exposure of the kidney on January 10, 1935, showed a normal kidney with a large solitary cyst of the lower pole measuring 4 inches in diameter. The cyst was resected as described and the patient's convalescence was uneventful. The wound healed completely by the twelfth day and the patient was discharged from the hospital January 24. Subsequent health has been excellent.

Case 3.—Schoolmistress, aged fifty-two years, was referred by Dr. Leo Clowes on March 24, 1935. She stated that since childhood she had suffered with intermittent distress in the left upper abdomen and flank. Recent indigestion had been accompanied by severe left lumbar pain with paroxysms of nausea. There were no urinary symptoms, and general health was otherwise normal. Physical examination revealed no abnormalities except for a palpable tender left kidney. Blood Wassermann test gave negative findings. Blood chemistry studies and urinalysis indicated a normal condition. Phenolsulphonephthalein excretion was 65 per cent in two hours. Hemoglobin 85 per cent, erythrocytes 4,600,000, leukocytes 6,200. Cystoscopy showed normal bladder and both kidneys after catheterization excreted normal urine. Phenolsulphonephthalein output was normal from both kidneys. Flat x-rays showed no calculi but an enlarged left renal shadow

at the lower pole. Left pyelogram showed compression and slight distortion of the lower calices. A diagnosis of solitary cyst of the lower pole was confirmed at operation and a cyst measuring 3 inches in diameter was resected as described. The cyst was seen to connect with the inferior calix by a small channel at its base.

Fig. 4. Case 3. Diagnosis of solitary cyst was confirmed at operation.

Convalescence was uneventful. There was no urine drainage and the patient was up and about on the fourteenth postoperative day. The patient has since been in excellent health and has had no lumbar or upper left abdominal pain.

Case 4.—Housewife, aged fifty years, was first seen with Dr. Joseph Prendergast on August 14, 1934, complaining of frequency, dysuria, hematuria and left lumbar pain. Physical examination was negative except for slight left lumbar rigidity and tenderness. Urine con-

tained blood and pus in quantity and yielded colon bacilli on culture. Blood count was normal except for 12,000 leukocytes. Cystoscopy showed a diffuse ulcerative cystitis with pus and colon bacilli from either kidney. Phenolsulphonephthalein output was normal from both kidneys.

On medication, rest and ureteral catheter drainage with renal pelvic lavage, the condition improved and on August 20 an x-ray study

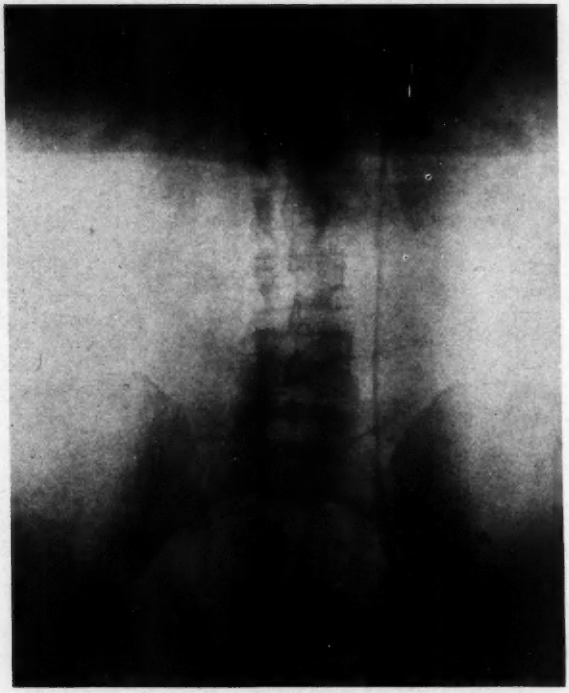

Fig. 5. Case 4. Diagnosis of solitary cyst of the lower pole of the kidney was confirmed at operation.

showed nothing abnormal except an enlarged left kidney shadow with a suggestion of some distortion and obliteration of the left inferior calix. The presence of a left renal tumor was considered. The patient was rather obese and on three subsequent examinations during the winter a normal dye output from the left kidney was obtained, but pyelography showed the same filling defect in the left lower pole. Intravenous urograms on four occasions were unsatisfactory as to de-

tail in outline of the left pelvis and calices. On April 28, 1935, the patient was again examined. She stated that she was in excellent health, had gained 20 pounds, and had no urinary symptoms, but that the persistent left lumbar pain was more and more severe, and that the pain extended into the posterior thigh so as to make walking difficult. The urinary tract was found to be uninfected and the bladder normal. Dye excretion from the left kidney was normal and a clear film of the left renal region showed an enlarged lower pole with obliteration of the lower calix on retrograde pyelography. Because of the good excretion from the left kidney and the lack of increased deformity in the outline after eight months' time, a diagnosis of solitary cyst of the lower pole was made. This was confirmed at operation and the cyst resected. At the base of the cyst there was a connecting channel about 4 mm. in diameter. The cyst measured 4.5 inches in diameter. Convalescence was uneventful and the patient left the hospital in good condition on May 15. Subsequent health has been excellent with complete absence of left lumbar pain and no pain in the left thigh on any type of exertion.

CONCLUSIONS

Four large solitary cysts of the left lower pole of the kidney were satisfactorily resected by the method described. Solitary cysts of the upper pole or of the convexity of the kidney might encounter, in their resection, larger vessels than at the lower pole. In this event resection of the protruding cyst wall with cauterization of the remaining sac might offer a safer method of obliteration. However, if the cyst connects with a calix or the renal pelvis, there is danger of subsequent urinary drainage with possible fistula. Complete surgical excision of the entire cyst with closure along the lines suggested seems the ideal procedure when possible.

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BIBLIOGRAPHY

1. Branch, Charles F.: Jour. Urol., 21:451, (April) 1920.
2. Lowsley, O. S., and Bishop, C. C.: Surg., Gyn. & Obst., 57:494, (October) 1933.
3. Quinby, William C., and Bright, E. F.: Jour. Urol., 33:201, (March) 1935.

ACTINOMYCOSIS OF THE KIDNEY IN INFANCY AND CHILDHOOD

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Actinomycosis of the kidney occurring in infancy and childhood is a very rare lesion and this, no doubt, is due to the fact that actinomycosis is a relatively rare disease in this country. That the subject of actinomycosis is rare in children is gleaned from a review of some of the textbooks on pediatrics in which the condition is either not mentioned at all or is dismissed with a brief statement that the condition is very rare.

Regarding the incidence of actinomycosis in childhood, Wooley and Oliver state that it is relatively rare. Sanford's and Voelker's survey of 670 cases of actinomycosis in the United States revealed only forty-five cases in children. Involvement of the kidney was one of the rarer locations of the disease. Good studied sixty-two cases of actinomycosis of the abdomen and found that there was secondary involvement of the right kidney in eight instances and of the bladder in three cases.

Figi and Cults studied a series of 450 cases of actinomycosis at the Mayo Clinic. They studied fourteen cases of actinomycosis in children between two and fifteen years of age. In this group nine were boys, five were girls, and these constituted approximately 3 per cent of this series.

Edwards, in his review of juvenile actinomycosis, states that in 50 per cent it occurs in the region of the head or neck, in 20 per cent in the thoracic viscera and an equal percentage in the abdomen. He does not refer to any specific cases in the urinary tract save to mention that on one occasion actinomyces were found in the urine of a girl of fifteen years.

If, as the above authors state, actinomycosis is a relatively rare disease in children, one may, therefore, be justified in saying that renal actinomycosis must be very rare. That this is true is evidenced by the fact that a rather careful perusal of the literature was rewarded by the finding of only four cases (Kunith, Peacock, Figi and Cults, Kindall), which, with the case about to be reported,

bring the total number available for study up to five. It is because of the great rarity of this lesion that we wish to report the following case.

CASE REPORT

D. P., white, female, aged ten years, was admitted to the Children's Memorial Hospital on June 30, 1933, on the service of Doctors Baxter and Schott.

The patient had had upper respiratory infections for six years; abdominal pain, three years; lassitude, eighteen months; loss of weight, ten months.

At the age of three years the patient developed a swelling and then a discharging sinus on the left side of the chest in front. The discharge continued for five months. At the age of seven years she developed pain and tenderness on the left side of the upper abdomen and this was still present when she was admitted to the hospital. This pain and tenderness was aggravated by bathing and rapid walking. At the age of nine years she began to lose weight. During a period of ten months she lost 29 pounds, so that her weight dropped from 80 to 51 pounds, which was her weight at the time of her admission to the hospital. Ten months before admission she began to have an afternoon fever that was present every day and varied from 100° to 101°. Her appetite was very poor. *At no time have there been any urinary symptoms.*

Previous illnesses included measles, pneumonia, varicella, pertussis and scarlet fever.

Tonsillectomy had been performed eight weeks before admission to the hospital.

Physical examination revealed that the teeth, heart and lungs were normal. A scar 1x2 cm. long was present in the left seventh intercostal space in the nipple line. There was tenderness upon palpation in the left upper quadrant. The left side of the abdomen was more prominent than the right side. Palpation showed the presence of a mass in the left upper quadrant of the abdomen compatible with an enlargement of the kidney.

Laboratory Report.—Twenty specimens of urine were examined and showed the presence of albumin, sugar or acetone. Many specimens showed the presence of red blood cells. One specimen showed gross hematuria during the course of carrying out a Mosenthal test. *Only one of these twenty specimens showed a few pus cells.*

The leukocyte count was 17,050.

The Mantoux test gave negative findings to 1:1000 dilution.

Roentgen-ray examination revealed no stone in the urinary tract. The roentgenogram showed an unusually large kidney outline on the left side.

Two intravenous pyelograms and one retrograde pyelogram showed a constant filling defect on the left side. The left ureter was dilated to the brim of the pelvis. Right pyelograms revealed a normal condition (Fig. 1).

Cystoscopic examination showed bladder and ureteral orifices to be normal. The left ureter was catheterized without difficulty or ob-

Fig. 1. Intravenous pyelogram. Left side shows an enormous enlargement of the kidney. Filling defect is compatible with the tumor and dilatation of the left lumbar ureter. Right side is normal.

struction. Examination of the urine obtained from the left side showed no growth at the end of six days and smears were negative for tubercle bacilli. A culture of bladder urine showed Staphylococcus aureus.

Phenolsulphonephthalein test: 75 per cent in two hours. Nonprotein nitrogen: 23.5. The Mosenthal test showed a variation in the specific gravity from 1.010 to 1.024. Blood pressure was 105/80.

From the findings a diagnosis of tumor, probably malignant, was made and operation advised.

Operation performed July 20, 1933, under ether anesthesia (H. L. Kretschmer) consisted of a left nephrectomy. The operation was very difficult due to the fact that the upper two-thirds of the kidney was firmly adherent to all the surrounding structures. The ureter was greatly thickened and was compatible with a thickened ureter such as one sees in tuberculosis. The upper two-thirds of the kidney was very hard and nodular. A great deal of perirenal sclerosis around the upper pole of the kidney made the nephrectomy very difficult.

The postoperative course was uneventful and the patient was discharged from the hospital September 5, forty-seven days after nephrectomy.

The patient was re-admitted to the hospital on January 11, 1934, because of redness, swelling and fluctuation in the scar. The abscess ruptured spontaneously and sulphur-like granules were present. Actinomyces were found in the smears. Suppuration of the wound occurred intermittently during the following fourteen months.

Following the removal of the kidney the child was given potassium iodide, 75 grains three times a day. The dosage was increased so that she was given 100 grains three times a day until a profuse nasal secretion necessitated its cancellation. The fistulous tract was irrigated with a 2 per cent solution of copper sulphate. In addition she was given five x-ray treatments.

The last examination of the patient, on March 10, 1935, showed a robust child whose nephrectomy wound was completely healed.

Pathologic Report.—Gross: The surgically removed left kidney was semispherical with a flat base. It weighed 145 grams, and measured 9 x 7 x 6 cm. in maximum dimensions. The capsule was thin and smooth everywhere, except of the upper pole, where it was roughened by firm, shaggy, fibrous adhesions. The kidney was uniformly hard throughout.

On surfaces made by cutting from the upper pole downward, the only kidney tissue which was evident grossly was the lower one-third. Here the cortex was 7 to 11 mm. thick and was in sharp contrast to the medulla. Here the cortical striations were distinct.

The upper two-thirds of the kidney was uniquely replaced by a well defined, firm, light brown to gray structure which was uniform throughout and demarcated from the uninvolved kidney tissue by a homogeneous gray fibrous tissue barrier 3 to 5 mm. thick throughout. It was diffusely mottled by homogeneous light gray islands from 2 to 5 mm. in diameter. From these islands a thick, tenacious exudate could be expressed. Surrounding these minute abscesses the structure was mottled by delicate streaks of light brown to orange which with the hand lens could be seen to extend to an island of orange-yellow

in the periphery within the cortical remnants, and located between the light gray abscesses. In the material expressed from these minute, orange-yellow places Actinomyces bovis were readily identified by floating the particles in a 10 per cent solution of potassium hydroxide and compressing between glass slides. From these particles the Actinomyces bovis were subsequently cultured on Sabouraud's maltose media and on 10 per cent oatmeal-agar media.

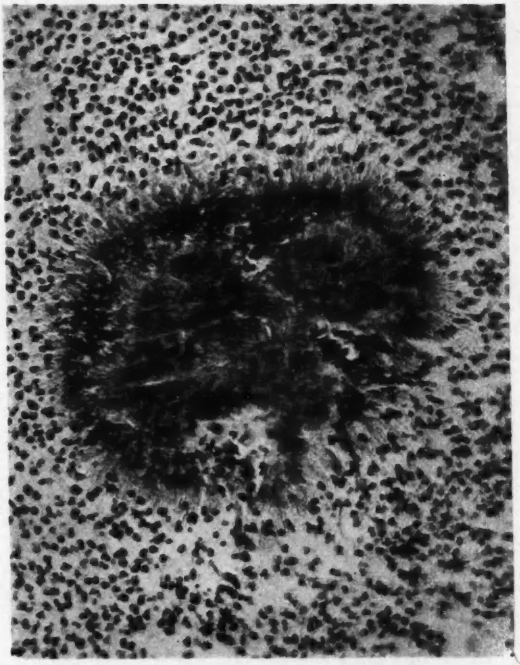

Fig. 2. Actinomyces bovis within the kidney, surrounded by inflammatory exudate. (High power magnification.)

Microscopic: Sections taken from various portions of the upper two-thirds of the specimen were identical. They were characterized by a dense suppurative process with clumps of polymorphonuclear leukocytes, many of which were partially disintegrated as in abscess formation. About every third to fourth abscess contained a clearly defined, eosin stained mycelium with adherent filamentous nodulations (Fig. 2). These were located in the periphery of the abscess, usually adjacent to the fibroblastic wall or clumps of tissue nuclei. The only

kidney tissue which remained near the mycelia were portions of necrotic tubular epithelium or only solitary nuclei.

Elsewhere the kidney was infiltrated by a dense fibroblastic reticulum which replaced tubules altogether or surrounded a solitary tubule, all of which was infiltrated diffusely by leukocytes and large mononuclear wandering phagocytic cells rich in fat granules. The barrier between the infiltrative suppurative process and the kidney tissue proper was of dense clumps of lymphocytes, plasma cells and fibroblasts. In the kidney tissue which remained the evidence of chronic inflammation was widespread.

AGE

Actinomycosis is generally considered to be a disease of middle life, although no age is exempt. Our patient was ten years old. The ages in the cases of actinomycosis of the kidney in children reported in the literature are given in the accompanying chart.

SEX

In their study of ninety-six cases of actinomycosis in general seen at the Mayo Clinic, Sanford and Magath found that eighty-four were males and twelve were females, many of whom were wives of farmers. In the four cases in children found in the literature, all were males; our case was a female.

SOURCE OF INFECTION

Various sources of actinomyces from the point of view of their entrance into the human organism have been discussed. One of the earliest was the vegetable source, as advocated by Bostroem. This investigator advocated the idea that the organism was carried to the human by grains or grasses. This opinion was seemingly substantiated by the fact that a number of cases had been reported in which penetration of the tissues by a straw, grass blade, or grain beard was followed by the appearance of an actinomycotic lesion. It has been demonstrated, however, that the organism with which Bostroem worked was not the Actinomyces bovis which is today accepted as the cause of actinomycosis in animals.

Actinomyces bovis is a facultative anaërobe, is rather easily cultured, and on solid media penetrates typically below the surface. It is easily killed by heat. The fungus which is derived from vegetable sources is aërobic, grows best on potato, and forms arthrospores. Actinomyces bovis has never been obtained from any but

animal sources and probably lives on the mucosa of the mouth and digestive tract.

As regards transmission of actinomycosis from human being to human being, this never has been definitely proved. Baracz saw a case in which he considered the disease had been transmitted by

Fig. 3. Radially disposed, club-shaped filaments of the central colony of Actinomyces bovis. (Oil immersion.)

kissing. Falge saw three cases of actinomycosis in children who were intimately associated in the same orphanage. He considered that this was evidence of the possibility of direct contagion in actinomycosis. Two cases which are frequently mentioned in this regard are those of Cope[10] and McWilliams.[37] In these instances

TABLE I. ACTINOMYCOSIS OF KIDNEY

Author	Date	Sex	Age	General Symptoms	Urinary Symptoms	Duration
1. Kunith	1908	M	4¾ years	Tumor of right lumbar region. Pus evacuated. Draining sinus remained	Pus and albumin in urine	About one year
2. Peacock	1925	M	8 years	Fever. Weakness. Abscess in posterior aspect of right loin produced a sinus draining a yellow discharge. General malaise	Pus in urine	Several months
3. Figi and Cutts	1931	M	14 years	Pain in right lumbar region. Weakness of right leg. Temperature. Enlargement in region of right kidney. Discharging sinus in lumbar region	Not stated	About six months
4. Kindall	1934	M	5½ years	Generalized abdominal pain. Pain in right flank. Tumor in right flank. Fever	None Urinalysis negative	One year
5. Kretschmer and Hibbs	1935	F	10 years	Pain and tenderness in upper left abdomen. Lassitude. Loss of weight. Fever. Loss of appetite	None Red blood cells in urine	Three years

actinomycosis occurred in the wounds following bites incurred during fights. It was suggested that actinomyces in the adversary's teeth were introduced into the patient's tissue by the teeth.

Wright reports a case of actinomycosis of the tonsils in a boy of twelve years. The tonsils were merely removed because of their enlargement. Later routine histologic examination revealed actinomyces in them and also in the abscess which developed subsequently. It appeared that the infecting organism had lodged in a tonsillar crypt.

Edwards, after a review of the variously suggested possible sources of entrance of actinomyces into the human body, concludes that the Actinomyces bovis is a normal inhabitant of the secretions of the mouth and gastro-intestinal tract of man and animals, and in certain instances may be carried into the tissues where it is able to establish itself. He notes the reports of the incidence of actinomyces in otherwise healthy individuals. Numbers of such instances have occurred in children.

The work of Lord is interesting in this regard. He found organisms identical with actinomyces in the carious teeth and tonsillar crypts of children who were otherwise healthy and, by injecting

NEY IN INFANCY AND CHILDHOOD

Preoperative Diagnosis	Treatment	Result	Method of Diagnosis	Remarks
stated	Right nephrectomy	Well eleven months later	Actinomyces demonstrated in surgical specimen	
erculosis of right ney	Right nephrectomy	Death twelve days after operation	Diagnosis verified at autopsy	Note: Five years previously this boy had been fed for six months with milk from a cow which developed an abscess of the left jaw. The cow died a few months later. This revealed the source of the infection in the boy
ated for typhoid r for three weeks another physician	Supportive measures. Deep roentgen therapy	Death ten months later	Actinomyces demonstrated in pus from sinus	
ure of kidney	Nephrectomy	Well five months after nephrectomy	From surgical specimen	1st operation—Appendectomy 2nd operation—Drainage of peri-renal abscess 3rd operation—Nephrectomy
ure of left kidney. bably malignant	Left nephrectomy. Potassium iodid internally. Deep roentgen therapy	Well two years after operation	From surgical specimen	Developed abscesses in scar. Smear from these abscesses showed actinomyces

this material into guinea pigs, was able to produce omental tumors of the histologic character of actinomycosis.

Of interest also is the report of Grosvenor, who found actinomyces in the crypts of the tonsils in four cases out of a hundred tonsillectomies, mostly in children.

When fungi are present in the mouth and gastro-intestinal tract, their implantation into the tissues may be favored by trauma, disease, and by accompanying organisms. While actinomyces of vegetable origin are not identical with that which causes actinomycosis in the human being, trauma of the buccal mucosa may be a factor in producing the disease. On the other hand, brushing of the teeth, which probably causes considerable trauma of the gingival mucosa, is not associated with the disease.

It would thus seem merely circumstantial evidence which associates the occurrence of actinomycosis with the penetration of the tissues by straws, grass blades, grain beards, et cetera. The trauma, allowing organisms present in the mouth to gain a foothold in the tissues, is probably the causative factor.

TYPES OF RENAL ACTINOMYCOSIS

Renal actinomycosis is discussed in the literature as existing in primary and secondary forms. The primary forms are those without a demonstrable entrance portal of the causative organisms, while the secondary form owes its origin to a hematogenous or metastatic infection from some primary lesion, or it may be the result of an extension to the kidney of the process in a neighboring organ.

In a purely clinical sense one may say that actinomycosis of the kidney may be termed primary when there are no signs nor symptoms of the disease in other organs and the removal of the affected kidney results in a cure. Such cases have been reported *"in adults"* by Israel, Kurnith, Kleinschmidt, Hunt and Mayo.

Recent authors concede that the conception of the kidneys as the site of a truly primary involvement is hardly acceptable (Rosenstein, Hunt and Mayo, Recht, Stoerck, Kleinschmidt and others).

Abbot was of the opinion that his case was primary in the kidney because at autopsy the largest focus was found in the kidney and because urinary findings and pain referred to the kidney furnished the most prominent symptoms.

PATHOGENESIS

The buccal cavity is the most likely portal of entry, for the most common site of the disease is about the head and neck (Rosenstein, Lord, Cope and McWilliams). From the primary site actinomycosis frequently extends by continuity of tissue along fascial planes. Skin is resistant; muscles and all viscera may be pushed aside or invaded. Extension of the disease by the blood stream is rare and the lymphatic system is peculiarly immune to invasion. From the lungs the process may penetrate through the pericardium and heart wall, into the interior of the heart.

The source and place of entrance of the Actinomyces bovis is usually difficult to determine (Good, Peacock, Robertson, Sanford and Magath). This is especially true in abdominal actinomycosis. The source of the disease in the abdomen has been described at the ileocecal region, by reason of local injury to the mucosa (Good, Peacock, Hunt and Mayo), or at other places in the gastro-intestinal tract (Jacobson, Ruhrah, Hunt and Mayo, Robertson, Sanford and Magath, Colebrook). From the place of entrance in the ab-

domen the kidney and adjacent tissue are most usually involved by direct extension of the disease process (Good, Peacock).

Although direct extension to the kidney is the usual process, actinomyces may reach the kidney through invasion of the arterial system (Ruhrah). Complete recovery following nephrectomy may suggest that the diseased kidney was the primary focus. In view of the recognized pathogenesis in actinomycosis, it is more probable that the primary focus elsewhere in the body had healed so that the only active focus remaining was in the kidney which had been excised, and that in this viscus, as elsewhere, the tissue had been better adapted to the growth of actinomyces (Robertson).

The kidney may be diseased by direct extension through the diaphragm of actinomycotic pulmonary disease (Christison and Warwick, Pinner).

The possibility of a descending infection from the latter to the kidney by actinomyces, in the absence of disease in adjacent tissue, has been described (Poncet, Recht); also by extension from actinomycotic prostatitis (Cohn).

It is more tenable to regard actinomycosis as a systemic disease, not localized, so that involvement of any portion of the body is readily understood (Cumming and Nelson). The primary lesion which gives access of the actinomyces may be self-limited or unrecognizable.

PATHOLOGY

Actinomycosis is a chronic suppurative process combined with the formation of granulation tissue wherever it exists. Its most distinctive gross feature is the presence of minute bright yellow to orange-yellow places, so-called "sulphur granules," or linear streaks of similar color, all of which is contained within the suppurative process. These characteristic granules consist of dense aggregates of branching filamentous, Gram-positive organisms and their products of transformation or degeneration. The radially disposed, club-shape filaments of the central colony are typical. The clubs are thickest distally. The abscesses containing the parasite are usually multiple and are surrounded by a wide zone of granulation or connective tissue. Diffuse inflammation is uncommon except in the later stages. Extension usually takes place by continuity, with the production of slowly advancing, indolent, densely indurated lesions which tend to break down in multiple areas forming

communicating channels and discharging sinuses. Almost any organ of the body may be invaded. Amyloid infiltration may follow long continued infection.

Actinomycosis may involve a kidney by way of the respiratory passages with a unilateral actinomycotic process in the lower lobe of a lung. The left lung is more frequently involved than the right, hence the lesion usually is in a single kidney. The penetration is downward, through or behind the diaphragm, to infiltrate this kidney and adjacent tissue, usually at its upper pole. This was the probable sequence in our patient.

The alimentary tract may be a portal of entry, the kidney being later penetrated by a direct spread through tissue to involve the kidney in any portion. In this regard it is unique that diffuse peritonitis is rarely observed, for rupture from the peritoneum through the skin may occur in one or many places. The process anywhere may infiltrate a blood vessel to produce a metastatic lesion in the kidney so that this organ may be involved within its substance, the process spreading outward from within the kidney to involve its capsule and perirenal tissue and other adjacent structures. Involvement of the ureter on the affected side is usual if the process within the kidney is extensive. Pus in the urine may be profuse, although absent in our patient, and Actinomyces bovis may be found after careful and repeated search. Other portions of the genitourinary tract may be involved and in the purulent discharge from the vagina the actinomyces may be similarly found.

Because of the frequent paucity of Actinomyces bovis in the kidney in histologic sections and because they are occasionally found only after the examination of many sections has been made, the question is raised as to whether the diagnosis is not missed occasionally on the assumption that the findings are only those of diffuse focal suppuration.

SYMPTOMS

In general we may state that there is no definite clinical picture which will serve to characterize renal actinomycosis. In cases in which the kidney involvement is but a part of a generalized actinomycotic infection, the symptoms are those of a severe sepsis and the kidney symptoms are of no particular prominence.

Where the renal involvement is of the so-called primary isolated or solitary type, the symptoms are, on the whole, those associated

with renal tumor, renal tuberculosis, or pyonephrosis, with which conditions it has been most frequently confused.

Because of the few cases accessible for study in children, it is hardly possible to determine any uniform picture of isolated renal actinomycosis. However, the presence of a chronically draining sinus at or near the kidney region, especially with subsequent involvement of the kidney, warrants a search for Actinomyces bovis in the absence of other proved primary etiology. The outstanding symptoms in the case herein reported are: fever, abdominal pain, lassitude, and loss of weight, with the physical findings of a chronically draining sinus and enlarged left kidney.

REVIEW OF CASES IN CHILDREN

In a review of the four cases in children that we have found in the literature the clinical picture was as follows:

Fever.—Fever was present in two cases as well as in the case reported in this paper.

Pain.—Pain in the renal area was present in the case of Figi and Cutts. The pain in part is probably due to the disease in the kidney itself and also to thickening of the renal capsule and the infiltration of perirenal tissues leading to extensive perirenal sclerosis. The enormous perirenal sclerosis is quite constant and should arouse one's suspicions of the possibility of actinomycosis in cases in which there is some doubt regarding the nature of the pathologic changes and symptoms before the operation.

The persistence of a fistula following an operation upon the kidney or the formation of a spontaneous fistula should arouse one's suspicions that we may perhaps be dealing with actinomycosis. The extensive appearance of nodules, although not always present in the early onset of fistulæ, are certainly signs of great value.

Urinary Symptoms.—Renal actinomycosis rarely presents bladder symptoms, in which respect it is quite the opposite to renal tuberculosis, in which bladder involvement and bladder symptoms play so prominent a rôle in the symptomatology. In none of the cases recorded in the literature was mention made of bladder involvement or urinary symptoms in children.

Diagnosis.—All authors agree that the diagnosis of renal actinomycosis is difficult and that the condition is most frequently con-

fused with tuberculosis or tumor, and that in the largest number of cases the diagnosis is made either at the time of operation, upon examination of the specimen at the time of its removal, or at the autopsy.

The pre-operative diagnosis must rest upon the demonstration of the fungus in the urine.

Attention must be called to the fact that the demonstration of the fungus in the urine does not necessarily mean that the kidney is the seat of actinomycosis, as it is possible for the fungus to be found in the urine without renal involvement. It has been shown that an actinomycotic abscess has ruptured into the bladder and prostate and, hence, fungi were found in the urine.

As a great aid in focusing one's attention upon the possibility of renal actinomycosis is the history of a preëxisting actinomycosis elsewhere in the body. The presence of renal actinomycosis may be suspected in all cases presenting evidence of a kidney lesion that may lead to a presumptive diagnosis of renal tumor or tuberculosis which cannot be proved. Under these circumstances repeated and most careful examination of the urine for actinomyces is in order. It is in the group of cases with pre-existing actinomycosis that the diagnosis is, or should be, more easily made than in cases without such history.

In our case the patient gave a history of having had a lesion of the seventh rib that was operated upon elsewhere before she came under our observation. It was not possible to ascertain the diagnosis made at that time.

Furthermore, in cases in which a perirenal abscess has been opened and drained and following which a sinus persists, the removal of tissue for histologic examination will often establish the diagnosis.

In rare instances the cystoscopic examination will demonstrate the presence of actinomycotic changes in the region of one or the other ureteral orifice.

Pyelography.—Pyelography in the diagnosis of renal actinomycosis has been of little value. As a matter of fact in cases in which pyelograms were made, the pyelograms led to wrong conclusions. A review of the cases in which pyelography was carried out showed the presence of filling defects typical of and compatible with tu-

mor, whereas others showed changes in the pyelograms that were interpreted to be due to renal tuberculosis.

In our case, because of the presence of a tumor mass and because of the configuration of the pyelogram, a diagnosis of tumor was made. It would appear that the changes in the pyelograms due to actinomycosis are not constant or characteristic.

Treatment.—Nephrectomy in cases of unilateral actinomycosis, unless extensive involvement of other organs is present, is the operation of choice. Here, as in renal tuberculosis, the *absence* of disease in the other kidney must be established, as far as this can be done, by a careful study of the urine is well as by pyelography, and although the pyelograms obtained are not typical, any deviation from the normal in a patient with actinomycosis in the opposite kidney should merit most careful study before nephrectomy is done.

Various treatments of the postoperative wound have been suggested, such as leaving the wound wide open, packing the wound with iodoform gauze, et cetera. In our case the wound was closed with cigarette drains and no attempt was made to treat it with iodoform packs or other chemicals, nor was the wound left wide open as has been recommended. The patient left the hospital on the forty-seventh postopertative day.

It has been recommended that medical treatment should be carried out after the nephrectomy. The drugs that have enjoyed widest popularity in the postoperative treatment of actinomycosis are iodide of potash and copper sulphate. Bevan recommends copper sulphate both locally and internally. For this purpose he irrigates the wound or the fistulous tract with a 2 per cent solution of copper sulphate.

The unsatisfactory status of the drug treatment is best illustrated by the numerous remedies that have been recommended, such as cinnamon oil and thymol (Meyers and Thiewes), tincture of iodine in milk (Chitty), intravenous injections of colloidal iodine (Pow), killed typhoid and paratyphoid bacilli (Epstein and Schoenholz), vaccine therapy employing a specific vaccine (Colebrook), roentgen ray (Bevan). Our patient was given 75 grains of potassium iodide three times a day.

SUMMARY

1. A case of actinomycosis of the kidney in a girl aged ten years is reported.

2. A review of the literature revealed only four cases in children.

3. The statement seems justified that this is a rare lesion of the kidney and it is especially rare in children.

4. It is often impossible to demonstrate the primary lesion or the portal of entry of the actinomycosis.

5. Renal actinomycosis is probably never primary in the kidney.

6. The persistence of a sinus after a nephrectomy for a chronic suppurative process in the kidney, in which tuberculosis of the kidney has been ruled out, should arouse our suspicions that we may be dealing with actinomycosis.

7. Likewise the presence of a persisting discharging sinus in other parts of the body should lead us to suspect that the renal lesion may be due to actinomycosis.

BIBLIOGRAPHY

1. Abbott, D. P.: Jour. A. M. A., 82:1414, 1924.
2. Baum, R.: Berl. Klin. Woch., 45:256, 1908.
3. Baracz, R.: Wien. Med. Woch., 1:1217, 1889.
4. Beregoff, P.: Jour. Mich. Med. Soc., 28:383, 1929.
5. Bevan, A. D.: Surg. Clin. of N. A., 3:899, 1923.
6. Cecil, H. L., and Hill, J. H.: Jour. A. M. A., 78:575, 1922.
7. Chitty, H.: Brit. Med. Jour., 1:347, 1929.
8. Cohn, T.: Berl. Klin. Woch., 48:1497, 1911.
9. Colebrook, L.: Brit. Jour. Exp. Path., 1:197, 1920.
10. Cope, V. Z.: Brit. Jour. Surg., 3:55, 1915-16.
11. Cumming, R. E., and Nelson, R. J.: Surg., Gyn. and Obst., 49:352, 1929.
12. Eckert, A.: Klin. Wchnschr., 1:1788, 1922.
13. Earl, H. C.: Trans. Royal Acad. Med. in Ireland, 23:339, 1905.
14. Edwards, A. C.: Am. Jour. Dis. of Child., 41:1419, 1931.
15. Epstein, N., and Schoenholz, M.: Calif. and West. Med., 30:395, 1929.
16. Falge, L.: Wis. Med. Jour., 7:710, 1908-1909.
17. Figi, F. A., and Cutts, R. E.: Am. Jour. Dis. Child., 42:279, 1931.
18. Ford, W.: Textbook of Bacteriology. Phila. and Lond., W. B. Saunders Co., 1927.
19. Garceau, E.: Renal, Ureteral, Perirenal and Adrenal Tumors, and Actinomycosis and Echinococcus of the Kidney. D. Appleton and Co., 1909.
20. Garrod, A. E., Batten, F. E., and Thursfield, H.: Diseases of Children. London, Edward Arnold, 1913.
21. Goyena, J. R.: Semana Med., 2:535, 1924.
22. Good, L. P.: Arch. Surg., 22:307, 1931.
23. Griffith, J. P. C., and Mitchell, A. G.: Diseases of Infants and Children, Phil. and Lond.: W. B. Saunders Co., 1927.
24. Grosvenor, L.: Ill. Med. Jour., 19:513, 1911.
25. Holthusen, H.: Handbuch der Urologie, 2:311, 1929.

26. HUNT, V. C., and MAYO, C.: Ann. Surg., 93:501, 1931; also Tr. Am. Assoc. G. U. Surg., 23:49, 1930.
27. ISRAEL, J.: Virchow's Arch., 74:15, 1878.
28. ISRAEL, J.: Chir. Klinik der Nieren Krankheiten. Berlin, August Hirschwald, 1901.
29. ISRAEL, J.: Folia Urologica, 5:447, 1910-11.
30. JACOBSON, H. P.: Med. Jour. and Rec., 132:342, 1930.
31. KERLAN, M.: Med. Jour. and Rec., 137:54, 1933.
32. KLEINSCHMIDT, P.: Arch. f. Klin. Chir., 120:658, 1922.
33. KINDALL, L.: Western Branch Am. Urol. Assn., 3:54, 1934.
34. KUNITH, N.: Deutsche Zt. f. Chir., 92:181, 1908.
35. LORD, F. T.: Bost. Med. and Surg. Jour., 163:82, 1910.
36. LUNDQUIST, C. W.: Brit. Jour. Urol., 3:1, 1931.
37. MCWILLIAMS, C. A.: Ann. Surg., 166:117, 1917.
38. MICHAILOFF, T.: Actinomycose des Voies Urinaires. These Lyon, 1899.
39. MYERS, H. B., and THIENES, C. H.: Jour. A. M. A., 84:1985, 1925.
40. NICAISE, V.: Encyclopedia Francaise d'Urologie, 3:118, 1914.
41. PEACOCK, A. H.: N. W. Med., 24:173, 1925.
42. PINNER, H.: Zt. f. Urol., 16:187, 1922.
43. POLAYES, S. H., and LEDERER, M.: Jour. Urol., 23:393, 1930.
44. PONCET, A., and BÉRARD, L.: Traite de l'Actinomycose Humaine. Paris, Masson et Cie, 1898.
45. POW, D. L.: Brit. Med. Jour., 1:549, 1929.
46. RACIÉ, J.: Beit. Zu Path. u. z. All. Path., 87:474, 1931.
47. RECHT, H.: Deutsche Ztschr. f. Chir., 224:414, 1930.
48. ROSENSTEIN, P.: Berl. Klin. Woch., 1918.
49. ROSENSTEIN, P.: Handbuch der Urologie, 4:218, 1927.
50. SANFORD, A. H.: Jour. A. M. A., 81:655, 1923.
51. SANFORD, A. H., and MAGATH, T. B.: Minn. Med., 5:71, 1922.
52. SANFORD, A., and VOELKER, M.: Arch. Surg., 2:809, 1925.
53. SAWYERS, J. L.: Jour. A. M. A., 36:1314, 1901.
54. SMITH, F. L.: Surg. Clin. N. A., 101:171, 1930.
55. STANTON, E.: Albany Med. Ann., 26:738, 1905.
56. STOERK, O.: Handbuch der Speziellen Path. Anat., 6:487, 1925.
57. TRAUNER, F.: Zentralbl. f. Chir., 57:1974, 1930.
58. WOOLEY, P. G., and OLIVER, W. W.: Actinomycosis in Abt, I. A., "Pediatrics," Philadelphia, W. B. Saunders Co., 5:685, 1924.
59. WRIGHT, J. H.: Jour. Med. Research, 13:349, 1905.
60. WRIGHT. J. W.: Am. Jour. Med. Sci., 128:74, 1904.

DISCUSSION

Dr. J. Dellinger Barney (Boston, Mass.): If I may do so, I should like to mention an experience of my own in connection with solitary renal cyst which is rather different from that of Dr. O'Conor. His handling of the situation was beautifully done, but those solitary cysts do not always occur in the lower pole. The one I refer to occurred about the midsection of the kidney opposite the hilum and it was a cyst about the size of a large orange. I trimmed off the walls close to where it sprang from the kidney cortex, leaving a large depression in the kidney substance where this cyst had burrowed into it. Thinking I might improve the situation I tried to dissect off the remaining lining. I found myself getting into very abundant hemorrhage from the close proximity to the renal vessels. I was tempted to leave the matter where it stood because in several other cases I had simply trimmed off the cyst and that was all there was to it and not one has recurred so far as I know. But my assistant at the time said, "Why don't you swab it out with Zenker's fluid?" So we called for Zenker's fluid and swabbed it out. He said, "We use that in brain cyst, why not in kidney cyst?" So that was done and beyond making a little more than the usual amount of reaction postoperatively, the patient recovered all right and nothing has been heard since from the cyst. I don't believe it has recurred. I mention it for what it is worth. Using Zenker's solution may not be a justifiable thing to do, but it worked very well in this case. I don't know that it has been used before.

Dr. E. Granville Crabtree (Boston, Mass.): I think that Dr. O'Conor's operation is decidedly a nice operation. I will speak along the line that Dr. Barney has indicated as to the advisability of always excising. For the past eight years in those solitary cysts, I think in sixteen cases, that have come to my hand I have done no resections. I have done as Dr. Barney has mentioned, excised the edges of the cyst a little back into the kidney tissue and then controlled hemorrhage by a button-hole stitch. Seven of those cases have been followed and there is no evidence from any source, including pyelography, that the cysts have recurred.

One patient died from an intercurrent condition and at autopsy the kidney showed only a depression in which the perirenal fat had adhered to the bottom of the cyst. In all of them we have packed gauze into the cuplike depression. I believe that it is not always necessary to do so elaborate an operation as O'Conor's for cure of renal cyst.

One or two things regarding the origin of the cysts and the differential diagnosis might be apropos here. One of them is that certain types of renal injuries give rise to a cortical fragmentation which opens into the pelvis but remains intracapsular. It should be the cause for formation of a communicating cyst, one that connects with the kidney pelvis. During the past year a college student accidentally wrapped himself around a pine tree when skiing down a hill, and ruptured the kidney at its lower pole intracapsularly. Now five months have elapsed and he has a cystlike formation which is like in appearance to a subcapsular cyst in the lower pole of his kidney. Since I have plates of the original injury I may eventually add further data on the end-result.

The other thing is that in the rare conditions which seem to be my lot at the present time, there are two things well worth keeping in mind. One of them is the perirenal hematoma which will give rise to a cyst adherent to the capsule of the kidney. After the blood clot has remained in position for a time the solid particles merge into the wall and leave a pure serum cyst. The other condition is a traumatic cyst apparently of the contusion variety, in which the kidney capsule splits and the hematoma forms between two layers of capsule, giving rise, therefore, at that position to a cyst of the same type.

Let me again express myself in favor of a more conservative approach to these cysts than Dr. O'Conor advocates, except where they communicate with the pelvis.

DR. GEORGE R. LIVERMORE (Memphis, Tenn.): Dr. Barney said that solitary cysts are not always at the lower pole but may be at the upper pole or some other part of the kidney. We encountered a case in a woman seventy years of age who had a cyst that came off from the anterior face of the kidney, involving the pelvis and the whole lateral aspect.

We attempted to enucleate the cyst and got into the same trouble

that Dr. Barney had with excessive hemorrhage. Feeling that cutting away the cyst would probably result in its return and not knowing about the use of Zenker's solution, I was in a dilemma with the severe hemorrhage and the possible return of the cyst. The function in the other kidney was perfectly good: 22 per cent in fifteen minutes; on this side it was 8 per cent, so I decided, regardless of the fact that it wasn't the right thing to do, to take the kidney out. The woman made a perfect recovery and had no further trouble. This was about ten years ago and she is still alive.

DR. WILLIAM E. STEVENS (San Francisco, Calif.): Following Dr. Barney's suggestion in a paper on "Conservative Surgery of the Kidney," published by him several years ago, I applied Zenker's solution to the remaining portion of the sac of a solitary cyst with excellent results. This cyst occupied the central portion of a lone kidney and was responsible for pressure deformity of the renal pelvis. I believe Zenker's solution is of considerable value in cases of this type.

DR. J. A. C. COLSTON (Baltimore, Md.): I have also had an experience of operating in a case in which the diagnosis was not made before operation. This patient had stones in the pelvis of the kidney. On exposure of the kidney I came upon two cysts, one attached to the lower pole and one, just as Dr. Livermore and Dr. Barney have described, right over the pelvis and close to the vessels. The stones were easily removed, the cyst at the lower pole was easily removed, but in attempting to excise the cyst over the vascular pedicle, severe bleeding occurred. I must confess that I had not heard about Zenker's solution, but I do not believe it would have controlled this because there was some big vein loose. So in that case nephrectomy had to be done. The other side was quite uninfected and there was quite good function, so I had no hesitation. I should have liked, of course, after the removal of the stones to have excised the cyst also, but the hemorrhage that Dr. Livermore and Dr. Barney have described made it impossible.

DR. JOSEPH F. GEISINGER (Richmond, Va.): May I simply mention a case that may be of some interest. It is my understanding that bilateral solitary cysts are quite unusual. It happens

that I have encountered such a case in a man about seventy years of age. There was a cyst upon one side in the central portion of the kidney, beautifully demonstrated in an intravenous urogram, and upon the opposite side an unexpected cyst at the lower pole of the kidney upon which an operation was necessary to relieve obstruction due to a large carcinoma of the bladder obstructing the right ureter. The only object in mentioning this case is to call attention to the possibility of having bilateral cysts, which I understand are quite rare.

DR. J. DELLINGER BARNEY (Boston, Mass.): I don't want to leave the impression that this Zenker's solution was used for the purpose of controlling hemorrhage, because I don't think it will. The hemorrhage in my case was not really severe and it was controlled by gauze pressure. It was used simply with the idea of possibly destroying the remaining lining of the cyst. As a matter of fact, I don't think one has to do it. I think that the simple trimming off of the cyst usually suffices.

DR. VINCENT J. O'CONOR (Chicago, Ill.): I should like to ask a question. In this type of cyst, such as the ones I reported, in which there is definite demonstrable communication between the cyst cavity and the calix, will the Zenker's solution insure the absence of urinary leakage postoperatively?

DR. BARNEY: No.

DR. O'CONOR: I think the avoidance of leakage is a rather important consideration in the handling of these things. I have apparently been unusually fortunate in this small group of cases in that the patients recovered most satisfactorily. They recuperated more rapidly than the usual nephrotomy or pyelotomy patient.

In this large group, Dr. Crabtree, were there some cysts that communicated directly with the pelvis?

DR. E. GRANVILLE CRABTREE (Boston, Mass.): In my discourse I excluded those. I said the simple cyst.

DR. O'CONOR: My drawing showed the cyst in the lower pole. One of the four patients, however, had a cyst well up on the con-

vexity of the kidney, but not so far up as to be in direct line with the main branching of the pedicle vessels. I can see where in resection one may encounter greater hemorrhage, depending upon the position of the cyst as related to the blood supply of the kidney. I offer this technic as one that has been very effective in my hands for this particular type of cyst and also to bring out the advantages of using ribbon gut material in doing renal resections, heminephrectomy and nephrostomy.

DR. HERMAN L. KRETSCHMER (Chicago, Ill.): I was greatly interested in Dr. O'Conor's paper in which he called attention to the difficulties that sometimes arise in making a preoperative diagnosis in cases of solitary cyst of the kidney. The ease or difficulty in making a preoperative diagnosis is directly dependent upon the quality of the flat roentgen film. It is possible in a good roentgen film to demonstrate the outline of the cyst. Any suspicion that one may be dealing with a solitary cyst can generally be verified by means of an intravenous urogram which will accentuate the outline of the cyst. In some instances the entire cyst has been beautifully demonstrated in this way. We rarely resort to retrograde pyelograms.

We have had no trouble with hemorrhage in the resection of these cysts.

I was greatly interested in the statements made by the various speakers that they do not resect the entire cyst but simply cut it off. This certainly simplifies the treatment.

MASSIVE STONE IN THE PELVIS OF A DOUBLE KIDNEY

ROBERT C. BRYAN, M.D.
Richmond, Virginia

C.C.T., male, aged thirty-one years, is married and has two children. He has had all the common diseases of childhood, also pleurisy at the age of fourteen years, and typhoid fever at fifteen years. He has had no rheumatism, malaria, scarlet fever or diphtheria. Several teeth have been extracted, but there have been no abscessed teeth. His tonsils have not been removed, but apparently are normal. He had an operation on the right sinus in 1931. His family history is insignificant.

Since the age of fifteen years he has been working as an interior decorator, papering and painting, handling turpentine, white lead, zinc, linseed oil and pigments, but no other chemicals. He is not careful to keep his hands out of the materials used in his business, but he does wash them carefully before eating. His diet includes practically everything, but he does not care much for sweets or fruits, preferring pickles and acid foods. Breakfast usually consists of grapefruit, cereal, bacon, egg, toast and coffee. A light lunch, which is usually eaten at home, consists of meat, one vegetable, bread and butter, coffee or milk. For dinner he has some sort of meat, two or three vegetables, bread and butter, coffee or milk. He has always liked bread, eating four or five or more slices at each meal. Several times a week he eats fresh fruit, but nothing between meals. About once a week he has a drink of alcohol, occasionally beer, and smokes a pack of cigarettes a day. He drinks at the present time three quarts or more of water, but formerly drank only one quart a day. He takes no exercise except in connection with his work.

The patient's physical history was essentially unimportant, other than the symptoms referable to the urinary tract, and some loss of weight.

He entered the Memorial Hospital, April 29, 1931, with a diagnosis of chronic pyelonephritis, with stone formation. There had been no pain until about three weeks previous to his admission into the hospital. The pain was chiefly about the right lower quadrant, radiating to the right flank and in the back on the right side. This was associated with frequent urination, poor appetite, some loss of weight, but no nausea or vomiting.

Physical examination revealed nothing abnormal, except marked tenderness in the right lower quadrant and a moderate amount of tenderness on both sides of the abdomen. No abnormal masses were felt, but there was slight rigidity.

X-ray, April 30, 1931, revealed a large number of stones in the

right kidney, which was enlarged. There was a minute shadow along the course of the right ureter close to the ureteral orifice which was considered a phlebolith. It was felt that it should pass easily if it were a stone, as it was very small. There also appeared to be a stone one-half by one-fourth inch in the pelvis of the left kidney.

Cystoscopic findings showed the bladder mucosa to be congested, much mucus, ora normal in size and location. Festoons of pus were pouring from the right side. No. 6 catheters were passed up both sides; phthalein appeared on the left side in four and one-half minutes, and at the end of thirty minutes had not appeared on the right side. Injection of 50 c.c. of sodium iodide was made on the right side and 5 c.c. on the left side. Pyelogram was made with the following report: "Right kidney pelvis is enlarged due to the chronic infection from the multitude of urinary calculi contained therein. The pelvis of the left kidney is approximately normal in its upper portion. There is some clubbing of the lower calix due to the stone in this location. The small shadow along the course of the right ureter mentioned previously is not a calculus."

Laboratory data: Urine from the bladder contained 4 plus pus; right kidney, 4 plus pus, occasional clumps of pus, rare red blood cell, few bacteria; left side, many bacteria, occasional pus cell, rare red blood cell, some mucus. Wassermann test gave negative findings. Nonprotein nitrogen amounted to 32 mgs. Phthalein output from the left kidney was 12 c.c., 18 per cent.

On May 14, 1931, operation was carried out under spinal anesthesia. A right kidney incision was made and the kidney, found bound down with numerous adhesions, was removed. The pathologic report on the specimen obtained was as follows: "Kidney 14x7x4.5 cm., weighing 300 grams. Stubs of extrarenal fascia are attached. Specimen reveals a markedly distended pelvis, in part lined with a fibrinopurulent exudate enclosing pus. Bulky concretions conform with the shape of the distended calices. The cortex varies in thickness between 0.1 and 2 cm., embracing abscesses, and has an outer surface mottled with small areas of hemorrhage. The capsule is adherent at several points. Under the microscope no bacteria were seen in smears or exudate. Renal structure is largely replaced by fibrous tissues embracing inflammatory infiltration and small abscesses. A ragged purulent exudate lines the pelvis. Pathologic diagnosis: renal calculi, chronic pyelonephritis."

The patient was dismissed from the hospital May 30, 1931, with a normal temperature, after an uneventful recovery.

Mr. T. was lost sight of until December 5, 1932, when he reported, stating that he had been passing blood and gritty material in his urine, and on several occasions had passed stones the size of a match head. Urinalyses showed four plus blood, many pus cells, no crystals, slightly acid reaction, trace of albumin. His weight was 148 pounds.

He was sent to the Memorial Hospital clinic for observation, where he passed from under my care, but in October, 1933, he again consulted me. He stated that he had been fairly well during the interval since I had last seen him, although he had been having intermittent attacks of dull aching pain in the left flank, the last attack six days ago becoming sharp, but not radiating, accompanied by dysuria and hematuria. Extreme tenderness was present in the left costovertebral angle. There had been no incontinence, retention or sudden stoppage, but slight nocturia. There had been puffiness under his eyes every morning with frequent severe headaches for the past two months. On examination of the abdomen there was a mass palpable in the upper left quadrant, which was firm, movable and tender on pressure, and was apparently the lower pole of the left kidney. Rectal examination revealed nothing abnormal, including the prostate, which was normal in size, shape and consistency, with no expression.

On account of the severe pain which he was having, he was again sent to the Memorial Hospital, October 16, 1933.

Laboratory data: Urine gave a neutral reaction, 1 plus albumin, 4 plus blood, 2 plus pus. Frequent urinalyses showed triple phosphate crystals, and occasional calcium oxalate crystals. Culture—Bacillus coli, Staphylococcus albus. X-ray examination of the left kidney showed a large calculus which apparently filled a considerable portion of the pelvis and calices. There was a single small calculus at some distance from the large one, and was probably in the end of the upper calix. No other calculi were seen in the tract. The kidney appeared to be very much enlarged.

His temperature was almost constantly subnormal during his stay in the hospital. He was dismissed November 10, 1933, to be under medical regime at home. It was at this time that Dr. Wyndham B. Blanton was asked to become associated with me in the care and investigation of this patient from a medical standpoint.

Dr. Blanton made a thorough examination of the patient and sent me the following reports:

Gastro-intestinal and respiratory tracts were normal; cardio-vascular and nervous systems normal. Reflexes active. Fluoroscopic examination of the lungs showed they were normal except for a few shadows at the hilus. Fluoroscopic examination of the heart gave the following measurements: one-half diameter of the chest was 19.5 cm.; long diameter of the heart 15.0 cm. The heart was not enlarged. Blood pressure was 120/80; temperature 97.8° F.; pulse 64; respiration 20. Height was 72.5 inches; weight 135 pounds.

Laboratory findings: Red blood cell count was 4,370,000, no poikilocytosis, no anisocytosis; hemoglobin 93 per cent; sedimentation rate 14 per cent in forty-five minutes. White blood cell count was 8,300; neutrophils 60 per cent; small mononuclears 40 per cent. Index was 0.9 per cent; creatinine 1.1 mgs. per 100 c.c.; blood sugar 100 mgs.;

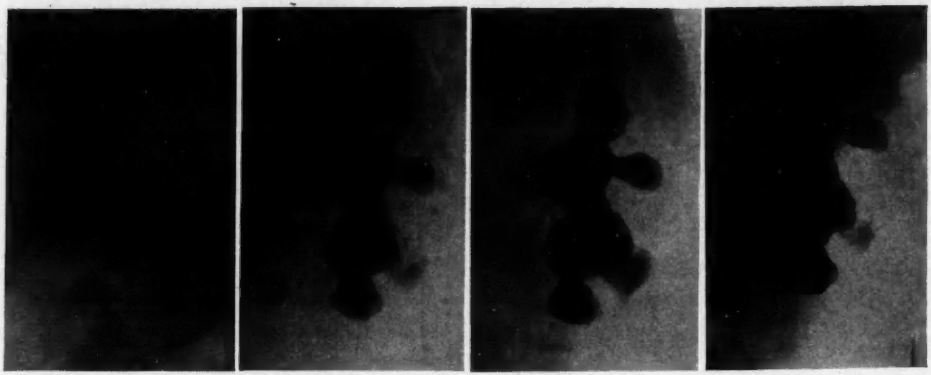

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Fig. 1. X-ray taken April 30, 1931. Right kidney removed May 14, 1931.

Fig. 2. X-ray taken December 5, 1933. Stone in left kidney, and small stone to the left which was removed from ureter of the upper kidney, July 7, 1934.

Figs. 3 and 4. X-rays taken July 6, 1934 and December 3, 1934. Size of stone about the same, with very little disintegration.

Figs. 2, 3 and 4 were taken from a series of x-rays which were made every month from October, 1933, until removal of the calculus.

blood urea 50 mgs.; non-protein nitrogen 37.6 mgs.; uric acid 4.6; cholesterol 182 mgs. Wassermann test gave negative findings. Blood calcium December 6, 1933, was 11.6 mgs.; August 21, 1934, 11 mgs.; December 29, 1934, 11.25 mgs. Total phosphorus was 25.2 mgs.; inorganic phosphorus 2.75 mgs.

Urine: A fair average of the large number of urinalyses done on this patient would be—straw color, cloudy, specific gravity 1.020, alkaline when titrated for total acidity, but at times a slight acid reaction to litmus, faint trace albumin, negative for sugar and acetone, mucus rare, pus 10-30 cells per high power field, with occasional clump, blood 10-20 cells per high power field, rare hyaline cast, occasional renal epithelium cell, occasional amorphous deposit. The presence of crystals varied. On several occasions the urine contained granular masses which, under the microscope, appeared to be triple phosphate crystals. The pH varied between 6.8 and 6.2. Culture: Staphylococcus albus and proteus. Two cultures in March, 1935, showed the disappearance of the proteus.

The Mosenthal test October 23, 1933, showed the greatest difference in specific gravity, 0.006; January 5, 1934, was 0.004. Phthalein output November 21, 1933, 58 c.c., was 24 per cent at the end of one hour; January 3, 1934, 246 c.c., 17 per cent. Basal metabolism August 22, 1934, was minus 24; December 21, 1934, minus 17. X-ray of the long bones showed no absorption.

Gastric analysis findings were: 30 total acid, 20 free acid; no blood and bile; lactic acid; large amount of mucus. Feces examined gave an alkaline reaction, and contained frequent yeast cells; no blood, parasites, vegetable nor muscle fibers were seen.

At this time we did not know the character of the stone in the kidney. Crystals in the urine are notoriously misleading, but, prompted by an article concerning the administration of urea to increase the solubility of calcium oxalate and uric acid and likewise to produce a diuresis, urea† was given from November 28, 1933, to January 25, 1934, except during Christmas week. He received ten grams daily. There was no marked change in the urinalyses, and no oxalate nor urate crystals were found.

It is interesting to note the variability of the blood urea nitrogen, and particular attention is called to the readings during the time of the urea medication.

11-17-33	23.9 mgs.	1-12-34	17.6 mgs.
12-12-33	32.6 mgs.	1-23-34	40.2 mgs.
12-15-33	34.9 mgs.	2-26-34	18.2 mgs.
12-22-33	23.3 mgs.	4-26-34	18.2 mgs.
12-29-33	16.7 mgs.	6- 2-34	17.7 mgs.
1- 3-34	32.6 mgs.	12-12-34	23.5 mgs.

†Dr. W. B. Porter, Professor of Medicine at the Medical College of Virginia, reports that in selected cases, and to encourage diuresis, he has used chemically pure urea, 90 to 100 grams daily. This drug cannot be given by the intravenous route.

On November 12, 1933, the patient was started on a low carbohydrate diet and encouraged in water drinking. X-rays every month showed no appreciable change in the size and consistency of the stone, although at one time, May 5, 1934, it was estimated that the stone showed an 11 per cent reduction in its size. This was temporarily encouraging.

On January 20, 1934, the patient was put to bed and rigorously starved to encourage acidulation. He was allowed only water, and continued his urea. A large amount of gritty material came away in the urine. On January 23 he began to resume his food. He lost 6 pounds during the time of the fast.

Mr. R. F. McCrackan, Associate Professor of Chemistry, Medical College of Virginia, who had been associated with me in previous cases, reported the following on the titration of the six samples of urine submitted to him:

First day, 12 hours,	1025 c.c. urine, total acidity equiv.	55.4 c.c.	N/10 NaOH
First night, 12 hours,	850 c.c. urine, total acidity equiv.	107.8 c.c.	N/10 NaOH
Total for first 24 hours		163.2 c.c.	N/10 NaOH
Second day, 12 hours,	1275 c.c. urine, total acidity equiv.	105.6 c.c.	N/10 NaOH
Second night, 12 hours,	925 c.c. urine, total acidity equiv.	67.7 c.c.	N/10 NaOH
Total for second 24 hours		173.3 c.c.	N/10 NaOH
Third day, 12 hours,	850 c.c. urine, total acidity equiv.	65.6 c.c.	N/10 NaOH
Third night, 12 hours,	750 c.c. urine, total acidity equiv.	80.5 c.c.	N/10 NaOH
Total for third 24 hours		146.1 c.c.	N/10 NaOH

"Hawk says any urine running under 250 c.c. N/10 NaOH is to be classed as an alkaline urine.

"The results seem disappointing on their face, and I fear that we did not get his urine appreciably acid at any time during the fast, but there is the possibility that it was more acid when excreted than the titrations showed, due to the fact that micro-organisms known to be present might have produced ammonia from the abundant urea. And it is possible that many particles of calcium phosphate of microscopic size went into solution in the urine, each particle using up some of the acid. If this did occur it was exactly what we were trying to accomplish. *In vitro* an acid urine acts very slowly on a large phosphate stone, but if the same stone were powdered, solution would go on much faster."

Throughout the first eight months of the year of 1934 the patient took dilute hydrochloric acid and either ammonium chloride or ammonium benzoate with astonishing regularity, the urine continuing alkaline. A ketogenic diet had been tried out on several occasions with more or less insistence and success, but at no time were we able to establish an encouraging acid state.

Fuller has been able to show that beta-oxybutyric acid was the bactericidal end-product of a ketogenic diet, and his suggestion, therefore, is that this drug be given orally, thus benefiting those

patients in a state of ketosis. In certain instances acidifying drugs, ammonium nitrate, ammonium chloride and ammonium citrate, along with a ketogenic diet, are of considerable value in bacilluria. In most cases with an appropriate ketogenic diet, a sufficiently low pH may be obtained without the use of drugs, and drugs are not to be used unless the pH of the urine under ketogenic diet is greater than 5.3. Patients with renal or ureteral calculi and bacilluria placed on ketogenic diet with acidification of the urine are definitely benefited. It is well known that complete eradication of the organism is most difficult.

Osterborg and Helmholz found that in order for the urine of the patients on the ketogenic diet to be bactericidal, the beta-oxybutyric acid must be present in a concentration of more than 0.5 per cent and the pH of the urine must be lower than 5.5. The greater the concentration of beta-oxybutyric acid, the lower the pH of the urine, the more bactericidal the urine.

The latter part of May the patient complained constantly of pain about the left kidney region, and the x-ray showed a definite stone in the ureter opposite the third lumbar vertebra which had apparently started its excursion downwards along the upper and inner border of the kidney. We could not understand this! We feared that at any time there would be an acute impaction, so we operated June 7, 1934, under general anesthesia, removing the stone. Convalescence was uneventful, and he left the hospital on the twelfth day.

Chemical analysis of the stone was done by Mr. McCrackan. The stone weighed 330 mgs., measured 10x7x3 mm., and contained calcium phosphate with no admixture of calcium oxalate, nor uric acid. If magnesium ammonium phosphate was present it was so small that tests for its presence left one in doubt.

In an attempt to dissolve stones in the kidney, I tried a series of experiments on the dog some fourteen years ago, which I presented as a paper before this body at its meeting in Richmond. These experiments had been prompted by investigations similarly carried out by Dr. Joseph F. Geisinger, of Richmond. We found at that time that a stronger solution than 1 per cent hydrochloric acid had an evident pathologic effect upon the urinary mucosa, and that this strength solution had a questionable influence upon the dissolution of stone. Randall, since that time, has recommended the use of phosphoric acid and reports very encouraging results.

Nature is forever changing and replacing one substance by

another. The marble in the graveyard disintegrates more rapidly than the granite because carbon dioxide of the air brought down by rain converts the insoluble calcium carbonate into soluble calcium bicarbonate. This explains the formation of the large caverns,

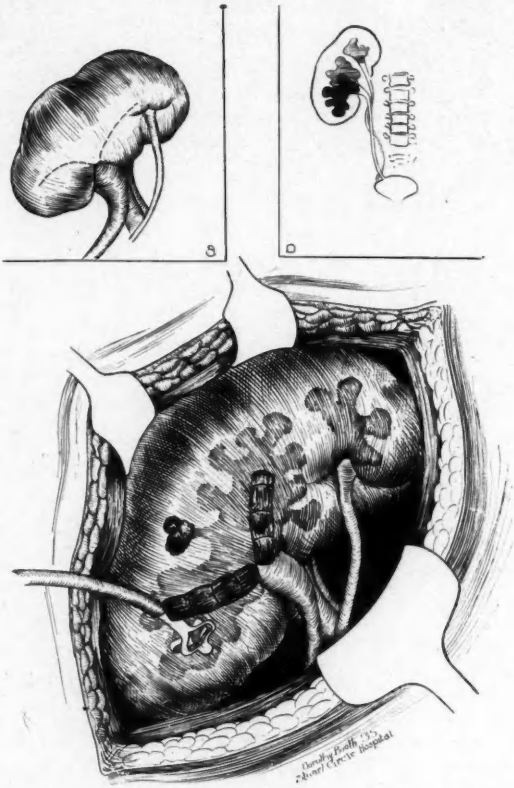

Fig. 5. *(a)* Double kidney showing line of incision made for removal of the large staghorn calculus. *(b)* The calices filled with stone. *(c)* Drawing showing type of operation and position of stone unintentionally left in kidney.

such as Mammoth Cave, and many other caves found in the States.

If the stone in question, calcium phosphate, could by the addi-

tion of chemicals, and the adjustment of the diet, be changed into a calcium soap such as the stearate, it is conceivable that it could be broken up more readily. The theoretic dissolution of renal calculi, the carbonates in particular, by air injection through the cystoscope is too far-fetched to be of serious consideration.

The question of why stone should occur in one kidney and not in the other when calcium and phosphorus metabolism is deranged by such conditions as hyperparathyroidism, osteitis fibrosa and avitaminosis, is difficult to solve. Randall has wondered whether it is due to a primary papillary ulceration. This brings me again in turn to the consideration of so-called essential hematuria, which state I have wondered might not be produced by strangulation of papillary varices by the muscularis spiralis papilla, thus giving rise to a hemorrhagic state directly analogous to anal hemorrhoids. It is interesting here to note that a voluntary milking muscle is said to be found in the breast of the female kangaroo.

Joly states that the crystals of calculi can be readily broken up by digesting them in suitable solvents *in vitro,* but no solvent is known for the colloidal framework which floats about in the pelvis of the kidney as a jelly-like cloud, inviting debris, crystals and germs to start again the stone formation.

Joly also states that stone formation is certainly favored by the presence of infection. In the first place it causes a precipitation of phosphates and carbonates in the pelvis of the kidney, and in the second place provides a large number of potential nuclei in the form of pus cells, epithelial cells and products of inflammation, thus creating a condition favorable for stone formation. He further states that the colloid matter—the frame or latticework—is unquestionably derived from the renal epithelium and that changes in the histology of the renal cells could influence, by an abnormal state, the production of this colloid matter, it having been well established that deficiency in vitamin A ultimately gives rise to changes in the epithelium in the urinary passage, most prominent of which is keratinization. It is by the use of cod liver oil and high vitamin A diet that this keratinized epithelium is changed back to the normal state and thus offers greater resistance to bacterial invasion.

Quinby, in his reply to my circular letter, states, "I once saw such a stone almost entirely disintegrate after the kidney which

bore it had become definitely infected. One would hardly advocate artificial infection of a single kidney, but in the case which I have on file the x-rays are most interesting."

A serum calcium, according to Barney, above 11 milligrams per 100 c.c. and a serum phosphorus below 3.5 milligrams per 100 c.c. should arouse suspicion of hyperparathyroidism. It has been stated that 0.95 per cent of the body weight is phorphorus and 1.9 per cent of the body weight is calcium.

Analysis of the urine in the hyperparathyroid state is interesting. Albright and Bloomberg, in discussing the urine in this state, call attention to the existence of granular casts. These casts are extremely fragile, and where the hyaline groundwork comes from is not clear, but these granular casts tend to change into hyaline as the urine becomes more acid. Apparently, these casts consist of a hyaline groundwork in which are deposited crystalloids. The factors concerned in their formation are the concentration in the urine of calcium phosphate and of the hydrogen ions.

The bones are the main storehouse for calcium and phosphorus. Hyperparathyroidism incites an increase in the production of the parathyroid hormone, the effect of which is to cause a disturbance in the metabolism of both calcium and phosphorus. Decalcification may proceed to the point where cysts form within the bones.

The increased excretion of calcium and phosphate is carried out chiefly by the kidneys. More solids in the normal state are excreted daily from the body by the kidneys than by the bowel. This very large excretion may result in the deposit of minute crystals not only in the pelvis but in the renal parenchyma. Theoretically, the removal of the parathyroid stops this excessive output.

Braasch states that the Mayo Clinic has had no success in demonstrating the relationship of the parathyroid to stone.

The x-ray of the long bones in our patient was normal, showing no demineralization.

Dr. Norman Patterson tells me that in six years work at the Tsing Kiang Pu General Hospital he has never seen a case of pellagra, beri-beri or scurvy, yet he has observed a very large number of calculi, particularly in Chinese children between the ages of eight and twelve years, who have had food imbalance with practically none of the vitamins necessary to life. How can we reconcile this clinical anachronism?

McCarrison calls attention to experiments in India which indicate that an iodine-poor diet produces stone and its sequelæ. The object of his paper is to announce that diets deficient in vitamin A predispose to stone formation. The richer class, being able to use butter and cod liver oil, do not have stone, while the poorer class who are not able to purchase these foods are more subject to stone formation. He further emphasized the fact that in his experiments the volume of urine excreted depends in a large measure upon the presence or absence of vitamin A bearing ingredients in the diet. When absent, or present in small amounts, the volume of urine is low, and when present in sufficient quantities the volume is normal or high.

In McCarrison's experiments it was noted that hard water has something to do with the causation of stone. Lime was added to diets, deficient among other things in vitamin A, with the result that the incidence of calculus, cystitis, hydronephrosis and pyonephrosis was greatly increased. Cystitis without stone was experimentally produced in rats with considerable certainty by diets deficient in vitamin A, but containing an excess of animal protein, a combination of food faults not uncommon in human sufferers with cystitis. He further remarks that, curiously enough, cystitis so produced was commoner in female rats than in the male, a strict analog to the human race.

The theory of vitamin A in the diet is that it builds up resistance and is therefore "anti-infective." Vitamin D is essentially "antirachitic" and is supposed to control the calcium and phosphorus ratio and metabolism. Vitamin D would apparently be particularly indicated, then, in calcium phosphate urolithiasis.

Our patient had been taking cod liver oil pretty regularly since December, 1933, and with devotion since July, 1934. Throughout the fall of 1934 it had been noticed on several occasions that the amorphorus crystals, urinary deposits and debris, under the microscope, were readily and immediately soluble in ether. This fact prompted the idea of an open nephrostomy and spraying the stone with ether for its dissolution, a surgical but problematic procedure that, as far as we know, had never been tried out.

De Tarnowsky states the following:

"Does ether act as a liquid or as a vapor? Ether volatilizes at 88° F. and boils at 95° F. In contact with living tissues it becomes a vapor in approximately twenty seconds. Its cooling action as a liquid lasts only a third of a

minute, to be immediately followed by the stimulant reaction of the vapor.

"As a gas, however, ether vapor is under tension and must follow the universal law of diffusibility of gases; consequently it must, and does in fact, penetrate every pocket, fold and corner, giving rise to a general, not local, hyperemia." (One gram of ether volatilizes to more than 320 c.c. of gas.)

Santy of Lyons, France, testing the effect of ether on the peritoneal cavities of rabbits, reported his findings:

"First twenty-four hours: slight congestion of the peritoneum.
"Third day: marked congestion of the peritoneum.
"Fourth day: lessened congestion, capillary dilatation.
"Twelfth day: macroscopically normal peritoneum; microscopically the omentum is slightly thickened.
"Twenty-fifth day: normal peritoneum."

For several years some of our local surgeons have been pouring ether into the abdominal cavity, particularly in cases of ruptured appendices, with apparently no damage, but with beneficial results.

The problem confronting us was an interesting one, and the fellows and active members will recall the letter sent out in December, 1934, inviting suggestions and recommendations about the line of surgical procedure. I wish to take this opportunity to express my appreciation and grateful thanks to each and every member of this society for the very prompt and splendid response I had to my inquiry.

Every letter possessed some thought, some worth-while suggestion, medical or surgical, from which notes were abstracted. An analysis and cross section of the opinions of these eminent gentlemen would surely form the foundation and framework for a most interesting contribution. The replies from Rathbun, Cabot, Braasch, Randall, Higgins, McKenna, Graves, Boyd, Geisinger, Thomas, Laurie and Hume were very illuminating and helpful. An overwhelming per cent of the fellows were opposed to the use of ether, though some modified their reply by saying that it might be used if an escape for the gas could be established. They had foreseen the troubles arising from pent-up power, and you may recall our experiment in filling a clamped appendix with liquid ether.

Mr. McCrackan reported the following on the ureteral stone removed in June, 1934: "November 5, 1934, it was already in the urine that he had passed. I wiped it dry and covered a small piece in a tube with ether, and in like manner covered a similar piece with a few drops of urine and half a tubeful of ether. I shook them and examined them many times until 4 P. M. and saw no evidence of any

change in either. I examined the various parts of the stone where I broke it up, and found some calcium carbonate along with the major constituent of calcium phosphate."

Our theory for the dissolution of the stone by this method was in consequence abandoned.

On January 24, 1935, Dr. F. M. Hodges reported the intravenous pyelogram on our patient as follows: "The genito-urinary tract shows an enormous calculus filling the left pelvis and calices. After diodrast: the kidney is symmetrically enlarged. None of the solution can be made out around the pelvis, middle or lower calices. Just above the upper branch of the stone there is a collection of the dye in what is probably a dilated calix. Near the upper pole there is a small accessory pelvis with one or more small calices and a separate ureter which appears to enter the other ureter about 2 cm. below the ureteropelvic juncture. The emptying time was very slow. The ureter appears normal down as far as the fifth lumbar vertebra. Below this point we were never able to demonstrate the ureter. The pelvis and ureter were empty after four hours."

This revelation was a condition of affairs which we had never anticipated, so that on February 5, 1935, a confirmatory retrograde investigation was carried out. My notes on this procedure are as follows: "Urethra cocainized, and takes No. 24 F. cystoscope easily. Bladder normal in appearance and capacity. Mucosa somewhat paler than usual. At the usual location of the ureteral opening an os is seen which is apparently normal but for a slightly red crater, and is readily catheterized with No. 6 F. catheter and through which there is an immediate flow of clear, but flocculent urine. This we take to represent the lower or larger pelvis, the one possessing the stone. About 1 cm. below, and in line with this mouth, another opening is seen. This is somewhat smaller but otherwise normal and is likewise readily catheterized with a No. 5 catheter. This mouth we take to represent the upper pelvis. The flow of urine through this catheter is somewhat retarded, but finally starts up. Injection of 5 c.c. of indigo-carmine in the left basilic vein appears in the lower ureteral mouth, representing the upper pelvis, in seven and one-half minutes, and in the upper ureteral mouth, representing the lower pelvis, in six minutes. Following gravitation of 4 c.c. of 12 per cent solution of sodium iodide into the upper pelvis a pyelogram is taken, the report of which is: 'There are two ureters all the way down, with the upper pelvis and calices filled. The enormous stone previously reported shows about as before.'"

A small ureteral diverticulum opposite the fourth space is doubtless the location of the removal of the ureteral stone in June, 1934, which coming from the upper pelvis explains very satisfactorily why there had never been an impaction in the ureter from the lower pelvis, and also the inexplicable location of this stone, which had been traced in

its excursion downwards from above and was internal to the large staghorn, so that at one time we took it to be in the substance of the upper pole of the kidney.

Examination of the specimens obtained gave the following information: Lower os (upper pelvis) slightly acid, 4 plus blood, few small clumps pus, few epithelium. Direct smear, negative; culture, negative. Upper os (lower pelvis) slightly acid, 4 plus blood, two to six white blood cells per highpower field, many epithelium. Direct smear, Staphylococcus; culture, Staphylococcus.

It was about this time that I invited Mr. McCrackan to investigate and recommend various solutions designed particularly to dissolve calcium phosphate stones. We were fully appreciative of the work done by Randall with phosphoric acid solution. We likewise knew of hydrochloric, malic and lactic acids being used for renal lithiasis, but since we apparently knew pretty definitely the character of the stone which were were attempting to dissolve (from analysis of the ureteral stone) it was recommended by Mr. McCrackan that we use a 6 per cent solution of diammonium citrate, which will dissolve three kinds of stone, calcium carbonate, calcium phosphate and magnesium phosphate. It has no effect upon uric acid nor oxalates.

From January 12 to January 16 a series of animal experiments was carried out, in which double isotonic solution of diammonium citrate was used in the conjunctiva of rabbits, four applications being made, producing moderate irritation which after a few hours cleared up entirely.

A series of experiments were then tried on the dog, the ureters being catheterized and various strength solutions of diammonium citrate, 6 to 20 per cent, injected into the pelves of the kidneys.

Dr. Frank Apperly, Professor of Pathology, Medical College of Virginia, reported the following: "I have made a close study of the two normal and two injected kidneys from the dogs after the use of 10 per cent diammonium citrate. I am not able to distinguish any pathologic changes in the injected kidneys, except two small lymphocytic foci. Otherwise there are no changes in pelvic epithelium, ureteral epithelium, subepithelium tissues (except the foci mentioned) or collecting tubules. Perhaps for safety it might be well to try two more injected kidneys to eliminate the possibility of the lymphocytic foci being connected with the citrate infection."

It was further established that 2.7 per cent concentration of diammonium citrate is isotonic. It freezes at —0.56° C. A 6 per cent solution has above the same tonicity as average urine, and with the cryoscope it freezes at about —1.11° C. Solutions, therefore, could be made hypotonic or hypertonic. The 10 per cent solutions used on the dogs were very hypertonic.

Hexylresorcinol (S. T. 37) was added to the diammonium citrate solution for its bactericidal effect, there being no incompatibility be-

tween these two solutions. Much of the germicidal effect of S. T. 37 is thought to be due to reduced surface tension, and it was found that there was little change in the surface tension of a solution of hexylresorcinol when the citrate is dissolved in it.

Before making a search for a more suitable irrigating solution than those now occasionally used, we concluded that there were probably some objections to those recommended as best, such, for example, as phosphoric acid, acetic acid and malic acid. According to Randall a 1 per cent phosphoric acid solution has a pH of about 1.6 upon which its bactericidal value is based. Doubtless the secretion of urine soon changes the acid solutions used, to solutions having lower acidities except in cases of anuria, but the solvent effect on stones is at the same time reduced also. So any new substitute irrigating solution for phosphoric acid should be less acid, and should have considerable power to withstand the neutralizing action of the buffer salts of the urine. Such a solution could be prepared by mixing sodium acetate and acetic acid, or disodium citrate and hydrochloric acid, but it seemed more desirable to find some single simple compound that would show these properties when dissolved in water.

Terreil, in 1881, stated that 100 grams of citric acid when neutralized by ammonium hydroxide dissolved 6.01 grams of normal calcium phosphate, while 100 gram portions of hydrochloric acid, nitric acid, sulphuric acid, acetic acid, tartaric acid, and malic acid when similarly neutralized with ammonium hydroxide dissolved 0.655, 0.309, 1.050, 2.55, 4.56 and 1.12 grams respectively. The same year he stated that 100 grams of citric acid neutralized with potash dissolved only 1.90 grams of calcium phosphate, and he concluded that the ammonium salt had a far greater solvent effect on calcium phosphate than either potassium citrate or sodium citrate. E. Erlenmeyer concluded as early as 1857 that a diammonium citrate solution of 1.09 specific gravity at 38° C. had a greater solvent effect on calcium phosphate than did a triammonium citrate solution of the same specific gravity, or a 0.25 per cent solution of citric acid.

Experiments with diammonium citrate solutions showed that:

(a) Calcium phosphate renal calculi, triple phosphate calculi, and calcium carbonate were dissolved in one to three days *in vitro* at 40° C.

(b) Oxalate, cystine and uric acid calculi were not affected appreciably.

(c) The P_H of 2 to 20 per cent solutions was not far from 4.8.

(d) The surface tension of solutions was practically that of water, about 72 or 73 dynes.

(e) A 6 per cent solution froze at about —1.11° C., and a 10 per cent solution at about —1.76° C.

(f) Hexylresorcinol solutions 1:1000 (Commercial S. T. 37) were miscible with diammonium citrate solutions in all proportions without appreciable change in the surface tension of the S. T. 37.

(g) Moulds grew readily in the diammonium citrate solutions, a fact that might prove a serious objection to their use. Hence the addition of S. T. 37.

(h) Exposure of a dog's kidney to a 10 per cent solution of diammonium citrate for twenty minutes seemed to have no injurious or pathologic effect.

In consequence of these laboratory equations, it was decided to use 6 per cent solution of diammonium citrate for irrigation of the kidney following the operation for the removal of the stone. The operation was carried out March 22, 1935, at Sheltering Arms Hospital. Under general anesthesia, ethylene, and assisted by Doctors Geisinger and Cruger, the usual kidney incision was made, the perirenal tissues divided and the kidney exposed. It had pretty strong adhesions at the upper pole and also anterior to the pelvis, so that it was brought up in the wound with a little difficulty, and only after shoving back the adhesions and tying off several of them. The ureter of the upper plevis was located and it was somewhat anemic and white, in marked contrast to the ureter of the lower pelvis, which was of the normal pinkish color and size. This lower ureter was tied off gently with abdominal tape to prevent any crystals or debris getting into it during the operation. The retropelvic fat was very adherent and could not be stripped away satisfactorily, there being one or two large veins in the field which were ligated. Clamps could not be put upon the pedicle, so it was compressed very satisfactorily between the thumb and middle finger of the assistant. Prather's incision was made and there was a very free flow of blood, almost alarming at one time. Apparently, we went more through the kidney than through the pelvic structures. The intrarenal pelvis was deep in the substance of the kidney and its mucosa intimately adherent to the stone, but it was stripped back with gentleness and care and the prong in the lower calix was seized with forceps and the stone wriggled and twisted gently but firmly, and was removed apparently in its entirety without fracture, as we thought. The finger in the lower calix showed a great many smaller stones and sand, much of it being removed. There were some larger stones, probably a half dozen or more, the size of grape seed, which were likewise removed. This lower calix was irrigated over and over again with saline solution. The finger now put in the calices could detect no stone or gritty material. A pair of long curved forceps was shoved up from the lower calix to the convex border of the kidney and a four-pronged Pezzer catheter seized and drawn downward and left snugly in the lower calix for future

irrigation. Five interrupted catgut No. 00 sutures were put through the outer wall of the pelvis, care being taken to avoid puncturing the mucosa. Two big pieces of muscle tissue were cut from the raw edges, laid over the line of incision and the wound approximated, apparently satisfactorily, but there was still considerable oozing, so the operation was hurried up. The abdominal tape around the ureter was removed, the perirenal fat approximated with plain catgut No. 1, and a large soft rubber dam fenestrated tube was put in the lower angle of the wound and brought out alongside the Pezzer catheter. The muscles were brought together with interrupted chromic catgut No. 2 above and below the tubings, the fascia was sewn over this, with continuous black silk through the skin, and heavy large through-and-through silkworm gut sutures now snugly tied over a layer of gauze. Duration of the operation was about one hour and twenty-five minutes.

During the operation the patient became badly shocked and was given glucose and saline intravenously, also two doses of caffeine. He was returned to bed in a shocked condition and was ordered to receive 1,000 c.c. of saline and 5 per cent glucose, ¼ grain morphine and whiskey.

The large stone weighed 11.85 grams, the small stones (fifteen to twenty) 1.25 grams, and the sand 0.7 grams. On analysis these proved to be calcium phosphate.

Phosphoric acid solution (1 per cent) was first used for irrigation through the catheter because of the oozing of blood and the known influence of citrate solutions on hemorrhage. All evidences of hemorrhage having ceased by March 26, four days following the operation, the solution of diammonium citrate (plain) was used for irrigations, alternating with diammonium citrate and S. T. 37.

On March 30 this solution apparently caused pain and slight hemorrhage and was, therefore, discontinued, boric acid solution being substituted.

On April 8 the urine was alkaline; culture, Staphylococcus aureus.

On April 9 the P_H of the urine was 6.6 by the quinhydrone electrometric method. Dr. Latane Flannagan made the following report: "X-ray examination of the genito-urinary tract does not disclose the shadow of the right kidney. The left kidney is very much enlarged and there are numerous shadows, apparently stones, in the pelvis. There are other small shadows varying in size from mere specks up to those of 0.5 cm. in diameter, some of which are apparently in the calices of the kidney, and others along the anterior border of the kidney which are difficult to localize on one flat film. There is a drainage tube inserted in the left side. The relationship of the end of the tube to the kidney will require further radiographs also for localization."

This was very discouraging as we felt pretty well assured that

the large stone had been removed intact, and the numerous irrigations at the time of the operation and subsequently had washed away the remaining particles. We had evidently broken off and left the triangular stone in the middle calix.

On April 11, a vigorous acid ash diet was started, but the patient soon refused it and was allowed salt.

On April 16, Dr. Flannagan reported as follows: "X-ray examination of the left kidney with radiographs made in two planes at right angle to each other reveals several of the dense shadows previously reported within the pelvis of the kidney. There are numerous other smaller shadows which are without the kidney substance but in close apposition with the kidney. The tip of the drainage tube is in close contact with the stones in the pelvis. Comparison of this examination with that made on April 8 shows that there is apparently a reduction in the number of calcifications, particularly of the very small ones.

Here we may make some remarks on the surgery of single kidney complicated by the presence of stone. Mathé calls attention to the necessity of the keenest surgical judgment in attacking this class of cases and recommends an adequate incision for thorough removal of all fragments. Prather's incision is most surgically sound and is to be selected in these very large staghorn stones. Keyes recommends not suturing the incision in the pelvis and carrying out a decapsulation of the kidney at the same time, which breaks up the sympathetic nerves and thus relieves tension.

If such states as ptosis, extrarenal vessels, pelvi-ureteral stenosis, extrarenal pressure, fibrous tissue or similar mechanical impediments are present, these conditions should be corrected at the time of the operation to assure good drainage.

As for the kidney incision and breaking up of these large staghorn stones, the following suggestions have been made: Livermore, fulguration; Bugbee, radio knife; Boyd, silver wire; Quinby, high frequency; Clarke, dentist drill.

At the time of our operation there was no provision for fluoroscopy or immediate x-ray in the hospital and we are now satisfied that the triangular stone shown by the x-ray represents an articulate fragment in the middle calix, evidenced by the rounded facet, which had been overlooked at the time of the operation and had been unintentionally allowed to remain.

The patient left the hospital for his home on May 4. The carbon dioxide combining power was 48.5, indicating a mild degree of acidosis. For the first time since his illness the urine had been acid for several days.

Pyelogram, May 25, revealed multiple renal calculi but the number of stones was not as numerous as observed on the previous examination. The two dense large stones previously reported appeared now to be of about the same size. Some the smaller ones had disappeared and others had been reduced in size.

The patient's urine has continued acid since his return home, and the kidney is being irrigated twice daily with plain 6 per cent diammonium citrate solution, alternating with the 6 per cent diammonium citrate and hexylresorcinol. The latter solution causes a little discomfort, probably produced by the 30 per cent glycerin in the S. T. 37 which, raising the osmotic pressure, reduces the freezing point and thus acts as an irritant.

The problem of a solvent for all renal calculi that is harmless to the mucosa and withal uniformly reliable in its efficiency is a proposition which has not as yet been definitely established. Randall's splendid contributions and work with phosphoric acid, I believe, offers so far the most encouraging and happy results of any of the solvents now being recommended and employed for phosphatic stones.

Our conclusions and results with diammonium citrate in this case are not final or clinically satisfactory. Theoretically, this solution in definite instances of calcium phosphate stones does offer some advantages which I hope will recommend its trial in specific instances to the members of this society. I also hope that this report will be of sufficient interest to justify the members in making further research along this line.

REFERENCES

ALBRIGHT, F., and BLOOMBERG, E.: Hyperparathyroidism and renal disease. Trans. Am. Assn. Genito-Urin. Surg., 27:195-202, 1934

ALDRICH, C. J.: The use of piperazine in nephrolithiasis. New York Med. Jour., 72:542, 1900.

ALESIO, C.: Calculous anuria in congenital, single kidney; case. Giro. med. dell'Alto Adige, 1:69-78, 1929.

ALLEN, R. B.: Experiments on the physiology and course of compensatory renal hypertrophy. Proc. Staff Mtgs. Mayo Clinic, Vol. 9, 1934.

BADANES, B. B.: Magnesium, solvent in nephrolithiasis. Dental Cosmos, 71: 251-255, 1929.

BARNEY, J. D., and WATSON, J. L.: Some of the results of renal calculus. New Eng. Jour. Med., 102:63-76, 1930.

BECKERS, L.: Glycerin therapy of kidney calculi. Fortschr. d. Therap., 8:366-369, 1932.

BIELING, O.: Internal treatment of diathesis. Med. Welt, 6:229, 1932.

BLISS, A. R., JR.: Relation of vitamin A and vitamin D to urinary calculus formation. Jour. Urol., 30:639-652, 1933.

BRAASCH, W. F.: Conditions contra-indicating operation with stone in kidney and ureter. Minnesota Med., 3:387, 1920.

BRYAN, R. C., and CALDWELL, R. D.: Dissolution of calculi in renal pelvis and ureter. Jour. Urol., 7:295-305, 1922.

CASPER, L.: Non-operative treatment of kidney calculi. Fortschr. d. Therap., 6:45-49, 1930.

CIFUENTES, P.: Calculus removed from remaining kidney. Siglo med., 73:613-615, 1934.

CIRILLO, N.: Considerations on bilateral reno-ureteral calculosis and on calculi in single kidney. Clin. chir., 36:572-628, 1933.

COHEN, A. J.: Salyrgan (mercury preparation) therapy on extra-renal anuria combined with calculi of kidney. Geneesk. tijdschr. v. Nederl.-Indie, 72:1452, 1932.

CHUTE, A. L.: The diagnosis of renal stone. New Eng. Jour. Med., 202:60-63, 1930.

COLBY, F. H.: Urinary calculi associated with parathyroid disease. Surg., Gynec. and Obst., 59:210-214, 1934.

CROWELL, A. J.: Cystin nephrolithiasis, report of case with roentgenographic demonstration of disintegration of stone by alkalinization. Surg., Gynec. and Obstet., 38:87-91, 1924; also in Jour. Urol., 9:545-557, 1924.

CUMMING, R. E.: Treatment of bilateral renal and ureteral calculi. Jour. Urol., 32:600-623, 1934.

DILLON, J. R., and JONES, J. G.: Management of calculi in single kidneys, cases. Calif. and West. Med., 35:36-39, 1931.

EGOROFF, M. A.: Calculous anuresis in woman with one kidney; case. Vestnik khir., 16:213-215, 1929.

ERLENMEYER, E.: Ueber Bildung und Zusammensetzung des sogenanten sauren phosphorsauren Kalks. Heidelberg, 1857.

FULLER, A. T.: Ketogenic diet; nature of bactericidal agent. Lancet, 1:855-856, 1933.

FULLER, A. T.: Nature of bactericidal substance in urine and patients receiving ketogenic diet. Biochem. Jour., 27:976-982, 1933.

GAUTHIER, C., and CIBERT, J.: Two cases of calculi with anuria in single kidney. Jour. durol., 29:44-49, 1930.

GEISINGER, J. F., RUDD, W. F., and GREEVER, E. V.: Solubility of phosphatic kidney stones. Jour. Am. Pharm. Assn., Easton, Pa., 7:337-339, 1918.

GERAGHTY, J. T., and HINMAN, F.: Ureteral calculi; special means of diagnosis and newer methods of intravesical treatment. Surg., Gynec. and Obstet., 20:515-522, 1915.

GOTTLIEB, J.: Anuria from calculus in congenital single kidney. Vrach. dielo, 11:112-116, 1928.

GOTTLIEB, J.: Calculous anuria with congenital solitary kidney; case. Ztschr. f. Urol., 22:97-102, 1928.

HANSEN, F., and KAMM, B.: Biochemistry of glycerol treatment of nephrolithiasis. Biochem. Ztschr., 173:327-333, 1926.

HERMAN, L., and GREENE, L. B.: Calculus anuria in acquired single kidney. Jour. Urol., 32:623, 1934.

HEUMANN, L.: Combined administration of leukotropin (cinchophen preparation) and hypophysin (pituitary preparation) in treatment of kidney calculi. Med. Welt, 2:220, 1928.

HIRSCH, H.: Novalgin therapy of kidney calculi. Deutsche med. Wchnschr., 53:1603, 1927.

JAENICKE: A remedy for the dissolution of renal calculi. Zentralblatt für Innere Medizin, 25:329, 1904.

JOLY, J. S.: Etiology of stone. Jour. Urol., 32:541-577, 1934.

JOLY, J. S.: Stone and Calculous Disease of the Urinary Organs. C. V. Mosby Co., 1929.

JOSEPH, E.: Nephrotomy and pyelotomy of calculi of solitary kidney; case. Ztschr. f. Urol., 26:405-406, 1932.

JOSEPH, E.: Implantation of muscle into nephrotomy incision in order to pre-

vent hemorrhage after removal of calculi, especially from solitary kidney. Deutsche Ztschr. f. Chir., 234:817-823, 1931.

KEYES, E. L.: Operation on single kidney, especially for stone. Jour. A. M. A., 94:152-156, 1930.

DE LELLIS FERREIRA, E.: Os saes de lithina como dissolventes dos calculos renaes; cura de un calculo immovel. Brazil-med., Rio de Jan., 17:141-145, 1903.

VON LICHTENBERG, A.: Medical and surgical treatment of kidney calculi. Ztschr. f. arztl. Fortbild., 25:79-83, 1928.

MATHÉ, C. P.: Management of stone in solitary kidney and ureter. Surg., Gynec. and Obstet., 52:79-86, 1931.

MATHÉ, C. P.: The present day management of stone in the kidney. Jour. A. M. A., 96:657-662, 1931.

MCCARRISON, ROBERT: Causation of stone in India. Brit. Med. Jour., 1:1009-1015, 1931.

MEDES, GRACE: Proc. Soc. Exp. Biol. Med., 30:281-284, 1932.

MOIA, B.: Enormous calculi of congenital solitary kidney. Dia med., 3:990, 1931; also Rev. de especialid, 6:485-497, 1931.

MOOREHEAD, J. J.: Traumatic surgery problems. Jour. A. M. A., 76:1642, 1921.

MORGAN, J. L.: Nephrotomy for stone in remaining kidney; case. Memphis Med. Jour., 9:130-131, 1932.

NAUMANN, H.: Use of hypophysin (pituitary preparation) in calculi of kidney. Med. Klin., 25:1697, 1929.

O'NEIL, R. F.: Treatment of renal and ureteral calculi. New Eng. Jour. Med., 102:64-67, 1930.

OSTERBERG, A. E., and HELMHOLZ, H. F.: Determination whether ketonurine has bactericidal action. Simple technic for clinical use. Jour. A. M. A., 102:1831-1832, 1934.

PAILLARD, H.: Hydromineral cures in various forms of lithiasis. Marseille-med., 1:300-308, 1932.

PAPIN, E.: Conservative methods in surgical therapy of kidney calculi. Bull. et mem., Soc. nat. de chir., 57:1316-1323, 1931.

PAZZAGLI, R.: Recurrent calculosis in single kidney; suggested surgical procedure. Ann. ital. di chir., 12:1357-1374, 1933.

PRATHER, G. C.: A method of hemostasis during nephrotomy for large kidney calculi. Jour. Urol., 32:578-599, 1934.

PUGH, W. S.: Massive calculi in remaining kidney. Surg. Clin. No. Am., 11:495-498, 1931.

RANDALL, A.: Problem of recurrent renal calculi with consideration of a new preventive treatment. Trans. Am. Assn. Genito-Urin. Surg., 25:133-147, 1932.

ROBBINS, C. L.: Osteitis fibrosa cystica and renal calculi without hypercalcemia. Jour. A. M. A., 104:117-118, 1935.

RUGE, E.: Presence of calculi and pus in solitary dextrolateral kidney, with total absence of urinary system on left side in child in whom cystoscopy is impossible; case. Ztschr. f. Urol., 26:171-182, 1932.

SACKI, F.: Conservative therapy of kidney calculi. Deutsche med. Wchnschr. 58:1638-1640, 1932.

SANTY: Le lavage a l'ether. Lyon Chir., (June) 1914.

SCHONDUBE, W.: Treatment of calculi of kidney with hypophysin (pituitary preparation). Ztschr. f. Urol., 23:865-889, 1929.

SEGALL, P.: Treatment of kidney calculi with terpichin, a turpentine preparation. Fortschr. d. Therap., 3:286, 1927.

SEIDE, J., and ZINK, K.: Expulsion of kidney calculi after use of physormon (pituitary preparation). Therap. d. Gegenw., 74:139-140, 1933.

STRAUSS, O.: Piperazine in therapy of uric acid diathesis. Fortschr. d. Med. 51:357-385, 1933.

DE TARNOWSKY, G.: Ether lavage; its logical use, locally, as an antiaggressin. Surg., Gynec. and Obstet., 37:76-81, 1923.

TERREILL: Chem. News, 44:66, 1881; also Bull. Soc. Chim., 35:548, 1881.

TRANSABDOMINAL EXTRAPERITONEAL NEPHRECTOMY

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Every urologist is called upon not infrequently to perform a transabdominal transperitoneal nephrectomy. The most common indication for this operation is a large kidney tumor. The obvious reasons for such an approach are the necessity of more room and a better exposure, the desirability of an early approach to and control of the vascular pedicle and the importance of securing the pedicle before there is any extensive manipulation of the kidney, in this way avoiding the danger of squeezing tumor cells into the blood stream. May I say, in passing, that so far as my personal experience goes, I have often found it necessary, even with this approach, to do considerable manipulating of very large tumors, before safe and satisfactory access to the vessels is secured. With modern methods of pre-operative radiation of certain types of tumor and the resulting shrinkage in size of the mass, the approach to the vessels should be and is materially facilitated and can often be accomplished with very little or no manipulation of the renal mass. This operation is fairly well standardized and is adequately described and illustrated in most of the modern textbooks and in numerous articles, appearing from time to time in the literature. There are a few variations. Many operators employ a T-shaped incision with the vertical arm through the outer border of the rectus muscle or displacing the muscle, inward through its sheath—or through the aponeurotic layer to the outer border without opening the sheath. Cabot prefers a midline incision, thus avoiding injury to the nerve supply. It is usually desirable to supplement the vertical incision with a horizontal incision extending well out to the lumbar group of muscles. Young has recently advocated removing a large segment of the posterior parietal peritoneum covering the anterior aspect of the tumor mass, thus insuring a more radical removal of all tumor tissue.

There are a few minor disadvantages in this approach, chief among which is the occasional difficulty of keeping the intestines out of the operative field. This may occasionally involve a consid-

erable degree of mauling of the intestine with a resulting material increase in the degree of shock involved at the time of operation and an increase of postoperative ileus with its attending discomfort and perhaps risk. In fact, it seems fair to say that, even in those cases where it is relatively easy to keep the intestines out of the field, even a minimum amount of handling of the peritoneal

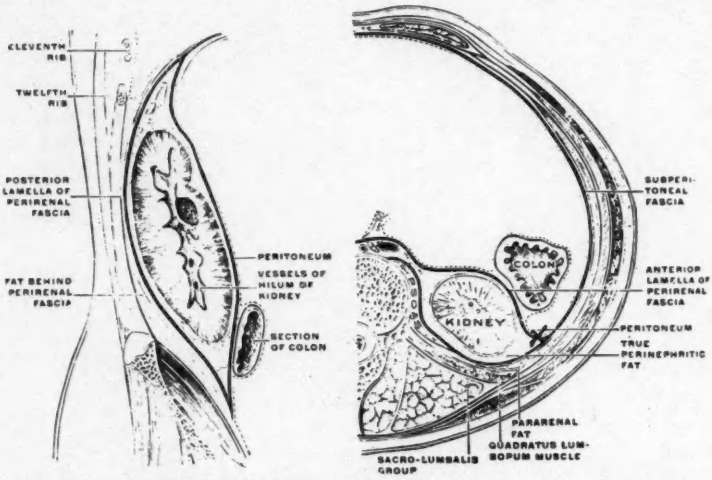

Fig. 1. From Gray's Anatomy, after Gerota. (*Left*) Fascia meeting above lost on the vault of the diaphragm. This is correct. It also shows the two layers meeting below the kidney. This is not correct in the majority of cases, since the two layers do not meet, but gradually thin out and are lost in retroperitoneal areola tissue. (*Right*) The fascia in a horizontal plane. The X marks the point where the fascia should be deliberately divided and reflected with the peritoneum in undertaking a transabdominal extraperitoneal nephrectomy.

contents does add something to the degree of shock and the operative risk. In spite of all of the above, the fact remains, of course, that these operations are frequently done with a relatively very low rate of mortality.

There are, however, other indications besides large kidney tumors for a transabdominal approach, such, for example, as in patients who have a spinal deformity with a resulting diminution or entire obliteration of the costal iliac space. This state of affairs may, and sometimes does, render the lumbar approach extremely

difficult or even totally impossible. Moreover, one may encounter in a patient with such a deformity a very large and grossly infected kidney (such, for example, as a calculous pyonephrosis) in which the lumbar approach is absolutely precluded and yet in which it would appear desirable, if practical, to avoid entering the peritoneal cavity for obvious reasons. The case report included in this paper very well illustrates the problems involved.

While it might seem that this operation would, if feasible, be clearly indicated in a certain small group of cases, I am convinced from a reasonably careful survey of the literature and the current textbooks that it is rarely employed. Many textbooks dismiss it with a few cursory lines and no attempt to describe the technic; others very briefly describe the technic by advising us to make the usual T incision to push the peritoneum and its contents well over toward the midline and remove the kidney in the usual manner. Now this description is entirely inadequate. I do not believe that this operation can be properly described, or, for that matter, properly performed, without a clear conception of the exact anatomy of the pararenal fascia and the peritoneal folds of the upper abdomen. Attention was first called to the pararenal fascia by Zuckerkandl many years ago. A little later it was carefully studied and more accurately described by Gerota and his name is often applied to it. Of course, we are all familiar with this fascia as it appears at the bottom of lumbar wounds. We pick it up with our forceps, nick it with knife or scissors, the characteristic lemon yellow fat appears, the opening is enlarged by cutting or tearing, the anterior layer *and* the peritoneum are pushed forward, the hand is inserted between the kidney and the posterior layer and the mobilization of the kidney proceeds. For the lumbar approach, this is all the anatomic knowledge that is required. For the anterior extraperitoneal approach one should, I think, have a rather more intimate acquaintance with this particular anatomic structure.

I have been rather surprised at the meager attention devoted to this structure in most textbooks on urology and also to the variation of its description in different textbooks on anatomy, including diagrammatic sketches of its anatomic arrangement. Basing my opinion on the fact and upon a few dissections which I have myself done on the cadaver, I believe that there is a considerable variation in the structure and tensile strength of the fascia. Generally speak-

ing, it may be briefly described as a prolongation of the subperitoneal fascia which in a transverse plane divides into two layers at the outer border of the kidney, one layer passing behind the kidney, thinning out a bit as it extends toward the midline and is gradually lost in the bodies and transverse processes of the vertebræ. The

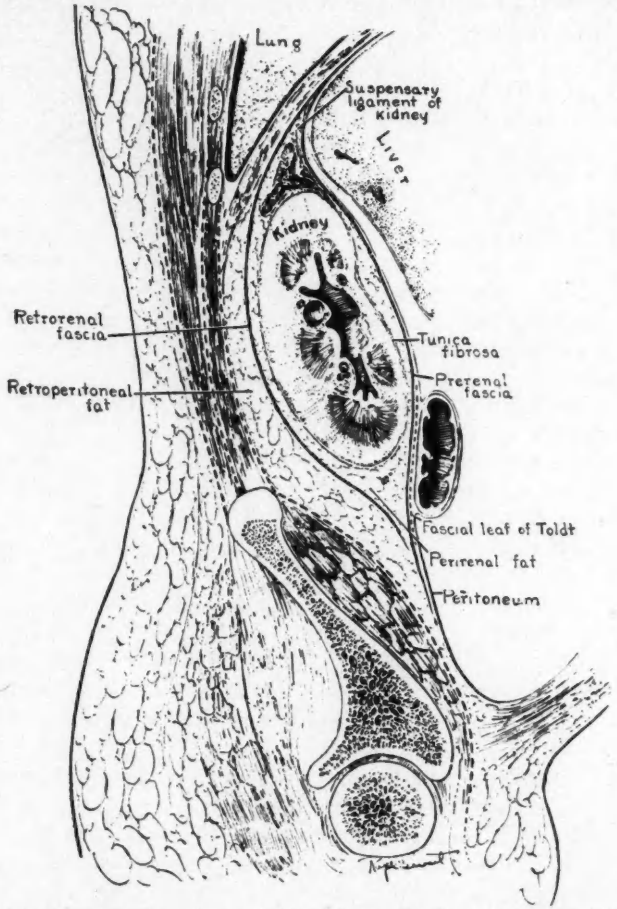

Fig. 2. From Lowsley and Kirwin's Textbook of Urology. This shows the perirenal fascia in a vertical plane, with two layers not meeting below the kidney. This is correct (Author's opinion).

anterior layer, which is rather intimately attached to the parietal peritoneum, passes across the midline in front of the great vessels and is continuous with the corresponding structure on the opposite side. Described in a vertical plane, the two layers reunite above the suprarenal body and the single layer gradually thins out and is lost on the vault of the diaphragm. In some anatomies the two layers are described as uniting below the kidney. This, I believe, is wrong. They do not unite but extend downward for a variable distance, thinning out more or less gradually until they are finally lost in the postperitoneal areolar tissue. For this reason, this structure is seldom recognized in the usual approach to the middle or lower ureter. The anterior layer has either dwindled to nothing or is more or less automatically pushed forward with the peritoneum. A reference to the diagrams shows this arrangement better than any short description could hope to do.

And now a word as to the important bearing which all of this has to the anterior extraperitoneal surgical approach to the kidney. Assuming that we have made our T incision and that the peritoneum has been gently stripped back laterally (even this part of the operation has to be done with great care and gentleness since the peritoneum of the upper abdomen is very thin and tears easily), with the operation at this stage we come down rather promptly, particularly in cases where the kidney is enlarged and the other structures pushed forward, to the point where the peritoneum blends with the pararenal fascia. At this point there is a natural tendency to continue in the same line of cleavage. If we do this we are almost sure to make a rent through the peritoneum. We should, I believe, at this point recognize and identify the fascia. It should be deliberately incised in a vertical direction, after which the fascia and peritoneum and colon can be mobilized to a moderate degree and displaced a little toward the midline. I am satisfied that if this fascia is kept in mind, a kidney of moderate size can be approached and removed extraperitoneally from the front with a fair degree of ease.

However, in the very large kidneys, perhaps the type in which we might be most likely to consider this operation, the problem becomes much more complicated, this time because of the arrangement of the peritoneal folds in the upper abdomen, particularly on the right side. The so-called triangular ligament of the liver is

formed by a reflection of the peritoneum from the vault of the diaphragm, extending down to the posterior superior aspect of the liver just lateral to the "bare spot" in the liver. This ligament apparently varies somewhat in length, breadth and tensile strength in different subjects. It is always enough to render the liver from a surgical point of view, extraperitoneally, a fixed organ. A some-

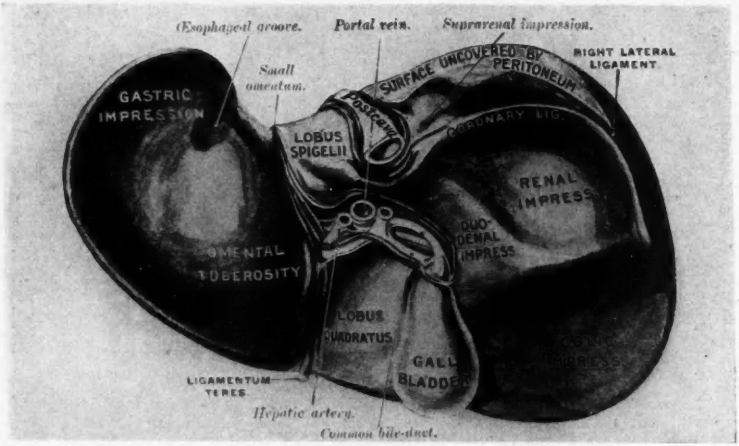

Fig. 3. From Gray's Anatomy. This shows the posterior and inferior aspect of the liver with the point of attachment of the right lateral ligament. This would serve to prevent any mobilization of the liver extraperitoneally.

what similar arrangement exists on the left side for the so-called suspensory ligament of the spleen.

Now, returning to our operative procedure, having moderately mobilized the fascia, peritoneum and colon, we still find ourselves faced with the problem of insufficient room. The kidney extends well up behind the liver and inside the bony thoracic cage. Apparently the only way to secure more room is further to displace the peritoneum inward and downward, but we are at once faced with the apparent impassé of the liver and its peritoneal attachments. The same thing applies, although to a lesser degree, on the left side because of the splenic ligament. I presume it may be anatomically possible to mobilize the liver extraperitoneally by stripping the parietal peritoneum from the vault of the diaphragm up to and

including the attachment of triangular ligament. So far, however, I have not been able to do it in any of my cadaver dissections. Surgically I am sure this would be so difficult as to be practically impossible. Such being the case, if at this point in our operation we find ourselves needing more room, the only possible way to obtain it is by going deliberately into the peritoneal cavity. In my own case, in an effort to secure more room, I found myself, almost before I knew it, in the peritoneal cavity.

The practical deduction from all of this is that, so far as my own personal attitude goes, transabdominal, extraperitoneal nephrectomy in very large kidneys, particularly where there is excessive enlargement of the upper pole, is so extremely difficult as to be practically impossible of execution. So that, desirable as it might seem in certain cases to keep out of the peritoneal cavity, I believe it is better in very large kidneys where the anterior approach is elected, to plan our route transperitoneally. In doing this operation I believe that we more or less automatically divide the pararenal fascia when we divide the outer leaf of the mesocolon. It is very simple then to displace the colon toward the midline. If more room is needed this can be obtained by rolling the liver downward and inward, which is readily done as an intraperitoneal procedure.

I was stimulated to write this paper by my experience with a recent case, the report of which will illustrate the point which I have tried to make.

The patient was a man of thirty-six who for five years had suffered from an aching pain rather vaguely referred to the right side of his abdomen and back. On occasions he would have rather sharp colicky pains, also vaguely referred to his right side and not radiating. The pain bore no relation to eating. It had been getting a little worse for the past year. Oddly enough, in spite of the fact that his voided urine was thick with foul pus, he had no bladder symptoms.

The findings on physical examination were briefly as follows: He appeared well nourished and not acutely ill. His temperature was normal, his pulse was 72, regular and of good quality. His blood pressure was 180/100. There was a rather loud systolic murmur heard at both the base and apex. The electro-cardiogram showed no interruption in conduction. His color was good and there was no edema of the extremities. The medical consultant made a diagnosis of "hypertensive heart disease" and expressed the opinion that, while this factor added considerably to the risk, he thought his circulation, if watched carefully, would stand up under any ordinary surgical procedure. A large mass could be palpated nearly filling the right side of

the abdomen. It was slightly movable and not particularly tender. It was apparently retroperitoneal, since colon tympany was noted in front and extremely well out laterally. Cystoscopic examination showed a mildly congested bladder mucous membrane; both ureter orifices were normal. Clear urine in normal spurts was noted coming from the left ureter, pure pus was oozing from the right side. Both ureters were readily catheterized with No. 5 catheters. Only a few drops of pus

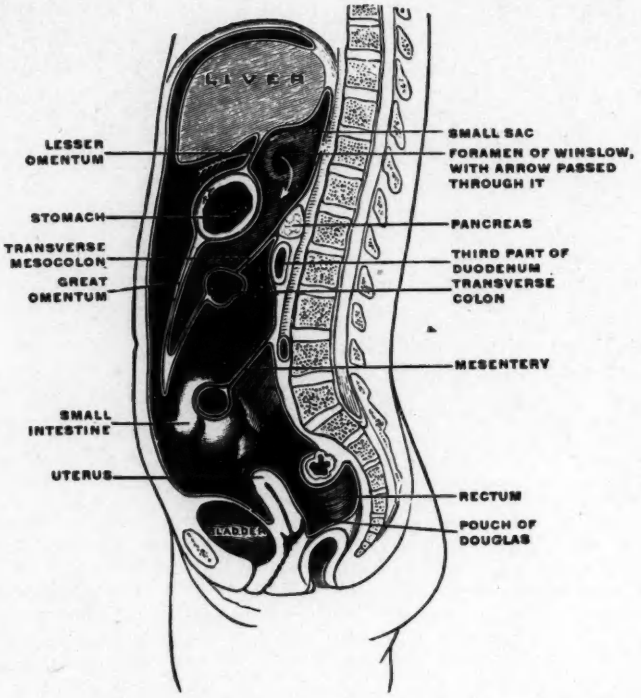

Fig. 4. From Gray's Anatomy. This illustrates diagrammatically the attachment of the lateral ligament.

were obtained from the right side, which showed colon bacillus on culture. Clear urine in normal flow was obtained from the left kidney. This showed no abnormal elements and was sterile. The x-ray showed a huge right kidney filled with multiple calculi, as shown in the accompanying illustration. A pyelogram looked much the same as the plain pictures. The x-ray also showed a fairly well marked scoliosis and a supernumerary rib on the right. This combination almost com-

pletely obliterated the costo-iliac space on this side. The total phenol-sulphonephthalein showed for four fifteen minute periods 30 per cent, 13 per cent, 7 per cent and 5 per cent, making a total of 55 per cent the first hour. There was an additional 5 per cent for the next two

Fig. 5. Enormous calculous pyonephrosis filling the right side of the abdomen. Note the marked scoliosis and the supernumerary ribs. This combination served almost entirely to obliterate the costal iliac space on the right.

one-half hour periods. While the total was a little low for a man of his age, the curve was good. He concentrated from 1006 to 1019. The Wassermann test gave negative findings. The blood chemistry studies showed urea 35.95, creatinin 1.63, sugar 94.2.

A right nephrectomy was advised and accepted. The problem of

approach was then considered. On the day preceding operation we placed the patient, conscious and coöperating, in the usual kidney position with pillows under the well side. The best we could get was about one finger breadth of costo-iliac space. We considered a transverse loin incision carried well forward, perhaps supplementing this with the resection of one or more ribs. We decided that this would not give us adequate room so concluded to perform a transabdominal operation and do it extraperitoneally, if possible. Past personal experience and textbooks were of little or no help in making our decision.

Under gas oxygen anesthesia a rather long pararectus incision was made, with its center at the umbilicus. The anterior sheath of the rectus was opened, the muscle displaced toward the midline and the posterior sheath opened down to, but not through, the peritoneum. This was stripped from the underlying fascia laterally. Even this stage of the operation was somewhat difficult because of the extreme thinness of the peritoneum. The vertical incision was now supplemented by a horizontal incision carried well out to the lumbar group of muscles. This provided abundant room as far as the abdominal wall was concerned. We then continued in our effort to strip up the parietal peritoneum which we found becoming increasingly difficult. One or two tears were made in the peritoneum and immediately repaired, with some difficulty, because of the thin, fragile character of the membrane. It then dawned upon us that before proceeding further we must recognize and divide the pararenal fascia. It was easily identified and divided in a vertical direction. After this it was a very simple matter to displace the peritoneum and its contents toward the midline, over the lower part of the renal mass. However, we found that most of the very large kidney extended well up into the bony cage of the thorax and behind the liver and that it was rather densely adherent. Obviously more room was needed for our manipulations. In an effort to secure this a large rent was torn in the peritoneum. This could not be repaired and the operation was deliberately completed transperitoneally (from the side, so to speak). In the course of separating adhesions the thinned out cortex of the kidney was torn and a considerable amount of pus was spilled in the wound. Following the removal of the kidney, the usual wound toilet was completed and the wound closed with fairly free drainage at the outer end of the transverse incision. In spite of a long operation (one and one-half hours) the patient left the table in good condition with a pulse of 90. However, he was given a transfusion of 500 c.c. before returning him to his room. At the end of thirty-six hours he was apparently doing well when he had a sudden circulatory collapse with marked tachycardia, fibrillation, et cetera. He reacted well to stimulation and rapid digitalization and did well for another forty-eight hours. He then had another sudden attack of tachycardia. This time he did not respond to treatment and died a few hours later. Autopsy was not granted.

SPONTANEOUS DISSOLUTION OF RENAL CALCULI

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In 1929 Barney reported before this Association the spontaneous dissolution of renal calculi in a patient twenty-two years of age. This patient had had a fractured femur and humerus which confined him to bed for a period of six months before the occurrence of the initial symptom of hematuria. The stones were composed of phosphates with a small amount of oxalates.

Nadeau in 1934 reported the disappearance of four calculi from the left kidney in a patient who had had a right nephrectomy for calculous pyonephrosis. The treatment in this case consisted of one gallon of distilled water daily.

Kearns in 1935 reported the complete dissolution without treatment of a large branched right renal calculus in a woman of forty-two.

Earlier reports from the literature are by Hasselstraum, who noticed diminution and almost complete disappearance with the passage of fragments in the urine of large right renal calculi in a woman of forty. She had no treatment.

Hellstrom noted spontaneous diminution and passage of calculi in several patients who had suffered fractures or other bone disease.

Scheele observed great diminution in the size of a large calculus over a period of two years, but finally removed the remaining fragments because of the symptoms.

Our attention was attracted to this question by the following case:

A white female child (C. H.), aged thirteen, was admitted to the orthopedic service of the Wisconsin General Hospital on March 15, 1934, with coxitis. She had been sick for three and one-half months. Three weeks before her admission to the hospital pus had been noted in the urine and radiograms showed large calculi in both kidneys.

Physical examination revealed an emaciated child who was greatly dehydrated. The right hip was flexed 45 degrees and rotated outward 45 degrees. The right knee was flexed 60 degrees. The right hip was in 20 degree flexion and 60 degree external rotation with abduction of 15 degrees. Any movement of the body produced great pain.

Fig. 1. Original radiograph taken March 16, 1934, showing large branched calculi in both kidneys.

Fig. 2. Radiograph showing no calculi, taken July 9, 1934.

Fig. 3. Excretory urogram made July 10, 1934.

Pertinent laboratory findings were as follows: The urine on admission was alkaline, but repeated examinations indicated that this alkalinity was not constant. About half of the specimens were reported as acid. A few pus cells and some blood cells were present in the urine. Hemoglobin was 65 per cent; red blood cells 4,400,000; and white blood cells 24,000. Blood cultures were sterile. Non-protein nitrogen was 28 milligrams in 100 cubic centimeters. The kidneys excreted 85 per cent phthalein in two hours. On two examinations the blood calcium was reported as 11.1 milligrams and 9.01 milligrams in 100 cubic centimeters. Radiographs revealed great destruction of both hip joints, a patchy destruction of the left ilium, and a small area of destruction in the right tibia. Large calculi were present in both kidneys.

Appropriate treatment was instituted for the hips and the patient was permitted to return to her home on April 11, 1934, approximately four weeks after admission. She returned on May 21, 1934, and great general improvement was noted. She was free of pain in her hips and she stated that she had passed a large amount of sandy material in the urine. She had saved a quantity of this material and on chemical examination it was found to be largely magnesium phosphate, a small amount of ammonium phosphate being present. The right hip was at this time completely ankylosed and the left was partially ankylosed. From time to time slight attacks of pain occurred on the right side which were thought to be ureteral colic. Radiographs on July 10, 1934 (approximately four months after the original admission to the hospital), showed complete absence of calculi in the renal area. One dense shadow 0.5 centimeter in diameter was visible in the right sacro-iliac region. An excretory urogram at this time showed normal kidney pelves and ureters.

Frequent observations were made from this time until the date of her last visit, on January 3, 1935. Steady improvement in the general condition was noted. The remaining stone in the right lower ureter disintegrated and was passed. The hips became ankylosed and with the aid of crutches the patient was able to get around with ease. Excretory urograms at the time of this last visit revealed normal kidneys and ureters.

It is our desire to comment not only upon the spontaneous dissolution of calculi, but also upon the development of calculi in patients suffering with bone injuries or bone disease, since the frequency with which such calculi appear suggests a definite relationship between these conditions. This has been mentioned by many observers. Squier calls attention to the formation of calculi in patients with osteomalacia, osteoporosis, coxitis, severe rickets and fractures. Joly discusses the formation of calculi in patients with fractured femurs, gunshot fractures of lower extremities, and

children with tuberculosis of the spine, hips or sacro-iliac joint. He also associates stone formation with severe diseases in which the bone is not involved, and thinks the frequency of stone formation in these patients is too great to be a coincidence. Paul reports twenty cases of renal calculi in ex-soldiers who had had severe bone injury, and stated that suppuration had occurred in nineteen.

Borman reported calcium phosphate stones in a child aged nine who had had a suppurating bone lesion. Numerous reports of calculi in children immobilized for tuberculosis of the hips or spine are available.

At the time of preparation of this paper there were on the urological service of the Wisconsin General Hospital four patients with renal calculi which developed following severe bone injuries. In three of these patients the stones were removed surgically and were found to be composed almost entirely of calcium phosphate. There was present in each instance a small amount of calcium carbonate and organic material. In the fourth patient the stone was not recovered. Brief résumés of these four cases are as follows:

B. M., white, female, aged 17, had suffered from osteomyelitis of the left tibia and both hip joints since December, 1927. Both hips are now ankylosed, but infection is still present in the left tibia. Examination on February 1, 1935, revealed multiple calculi in the left kidney and one calculus in the lower left ureter. A left nephrectomy was performed on April 18, 1935. Calculi were composed almost entirely of calcium phosphate. A small amount of carbonate and organic material was present.

O. O., white, male, aged thirty-six, fractured the second, third, and fourth lumbar vertebræ on June 15, 1933. He did not lose control of the bladder. He was confined to bed constantly and was admitted to the Wisconsin General Hospital on February 23, 1935. There was one large calculus in the right kidney and three small calculi in the bladder. Those in the bladder were crushed and removed. That in the kidney was removed by pelviolithotomy. Chemical examination showed that they were composed of calcium phosphate and carbonate with a small amount of organic material.

A. J., white, male, aged twenty-four, was first admitted to the Wisconsin General Hospital in November, 1931, with a gunshot wound of the left hip. This condition was treated by drainage and extension, but before his discharge on May 15, 1932, radiographs revealed a left renal calculus. A sinus from the hip persisted and the purulent material draining from this sinus showed Staphylococcus albus on culture. On March 13, 1935, he was admitted to the urologic service. Examination revealed the presence of a great many buckshot in the region

of the left hip, which was badly infected. There were bilateral renal calculi. These were removed by pelviolithotomy and found to be composed principally of calcium phosphate. A little carbonate was present.

W. S., white, male, aged twenty-three, was admitted to the Wisconsin General Hospital on March 10, 1935, stating that he was in an automobile accident in June, 1934, at which time the pelvis, the left acetabulum and left femur were fractured. The bulbous urethra was ruptured. A suprapubic cystostomy and repair of the ruptured urethra were done soon after the accident. He was confined to a hospital for twenty-nine weeks, five of which were spent in a body cast. His complaints on admission were difficulty in walking and shortening of the left leg. He also had difficulty in urinating, with frequency and dysuria. Radiograph showed a calculus 1 centimeter in diameter in the mid portion of the right ureter. As the urine was passed with great difficulty it was considered necessary to operate upon the traumatic stricture of the urethra and at the time of this operation a ureteral catheter was passed up the right ureter to the renal pelvis. The ureter was almost completely obstructed by the stone. This catheter was left in place for several days and after its removal the stone disappeared. It apparently was passed, though we did not recover it.

The constant factors in our cases and those in the literature are recumbency and relative immobility for a rather long period of time. Bone suppuration occurred in a large percentage of the reported cases, but apparently is not an essential to stone formation. The same is true of renal infection. In Barney's patient the kidneys were not infected.

Of the reported cases when mention is made of the chemical composition, calcium phosphate is said to be the chief constituent, with some carbonate present in many.

There is considerable evidence to lead one to believe that an important factor in the development of calculi in these people who have been subjected to long periods of recumbency and immobilization is local or general decalcification of the skeletal system with a great increase in the elimination of calcium through the kidneys. Hunter points out the fact that the skeleton acts not only as a framework, but also as a reservoir for calcium. This calcium is constantly being removed and replaced. Disuse of a part or a whole of the skeleton results in decalcification of the bones of the disused parts (Watson and Roberts). This can be demonstrated with the x-ray. Therefore, the patient with a local bone injury or lesion of a decalcifying type must eliminate from the body not only the calcium from the local lesion, but also that which is inci-

dental to a general decalcification brought about by the treatment required for his ailment. When calcium is removed from the bones it is eliminated from the body through the kidneys and bowels. Aub has shown that in certain conditions the calcium in the urine may be increased far above normal while the blood calcium remains within normal limits. Schultzer, Nachlos and others have shown that with decalcification the urine calcium is greatly increased. Hunter states that the excessive elimination of calcium for prolonged periods may lead to renal cellular degeneration.

Other factors undoubtedly play a part in the development of these calculi. The reaction of the urine is important. Phosphates are more readily precipitated from a urine which is alkaline or neutral, or only very slightly acid.

Recumbency alone or accompanied by swelling and edema of the pelvis and ureter caused by infection may result in stasis in kidneys which would ordinarily drain satisfactorily.

Our attention may well be directed to the prevention of these calculi. Hunter points out the effect of diet on the elimination of calcium through the kidneys and states that acid-forming diets double the excretion of calcium by the kidneys. He also cites the work of Aub, who found the elimination of calcium greatly increased by the administration of ammonium chloride. Twelve grams of ammonium chloride daily increased the urine calcium in a three day period from 0.1 gram to 1.1 grams. These measures lessen the tendency to precipitation by increasing the acidity of the urine.

Though it has been pointed out that infection is apparently not essential to the formation of these stones, it can not be said that it does not play a part in some cases and when present, appropriate measures should be adopted for combating it. At least it may render the urine more alkaline and increase the tendency to precipitation of the phosphates. Diluents aid in keeping the crystalloids in solution.

Spontaneous dissolution is apparently limited to calculi composed largely of phosphates. Factors which may play a part in the dissolution are a changed body position, increased muscular activity, cessation of the decalcification, and improvement in the infection.

The possibility of successfully bringing about the dissolution and passage of these calculi with the use of acid base diets, acidifying agents and diluents depends to a large degree, we believe, upon the compactness and chemical composition of the calculi. A pure calcium phosphate stone may be extremely compact and very hard. However, when a considerable amount of calcium carbonate is present, a calculus which appears hard effervesces freely and shows some tendency to dissolve when placed in a urine with a high acidity.

SUMMARY AND CONCLUSIONS

Five cases of nephrolithiasis are reported in which the calculi developed after severe bone injury or disease. In one case the stones were composed largely of magnesium phosphate and in three of calcium phosphate with a little calcium carbonate.

There seems to be a definite relationship between renal phosphatic calculi (usually calcium phosphate) and skeletal decalcification. This is thought to be due to the excessive excretion of calcium salts and other bone salts through the kidneys.

Spontaneous dissolution and passage of these calculi occasionally occur.

Acid base diets and acidifying drugs such as ammonium chloride increase the elimination of calcium through the kidneys and increase the acidity of the urine, and may be beneficial in the prevention of this type of calculus.

BIBLIOGRAPHY

1. Aub, J. C.: Jour. of Clinical Investigation, 7:97, 1929.
2. Barney, J. D.: Trans. Am. Assn. Genito-Urin. Surg., 22:55-64, 1929.
3. Borman, M. C.: Amer. Jour. Diseases Child., 40:804, 1930.
4. Hasselstraum: Upsala Lakarforenings Forhandlingar Upsala, 31:703, 1926.
5. Hellstrom, John: Ztschr. für Urolog. chir., 18:248-270, 1925.
6. Hunter, Donald: The Lancet, 218:897-904.
7. Joly, J. S.: Jour. Urol., 32:541-577, (December) 1934.
8. Jones, R. W., and Roberts, R. E.: Brit. Jour. Surg., 21:461-496.
9. Kearns, W. M.: Wisc. Med. Jour., 34:179-183.
10. Nachlos, I. W.: Personal communication.
11. Scheele: Ztschr. fur Urol., 18:528-656, 1924.
12. Schultzer, Paul: Amer. Jour. Med. Sci., 186:532, 1933.
13. Squier, J. Bentley: Lewis' Practice of Surgery. Vol. 8, Chapter 10.

FURTHER OBSERVATIONS ON THE EXPERIMENTAL PRODUCTION OF URINARY CALCULI

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In previous communications,[6,7,8] it has been demonstrated that if white rats were maintained for a period of time on a diet deficient in vitamin A, urinary calculi would develop in a large percentage.

In our researches, it was found that when animals were fed a diet deficient in vitamin A for a period of 250 days, postmortem study revealed the presence of vesical calculi in 88 per cent and of renal calculi in 42 per cent of the animals. It likewise was shown that if vitamin A alone were added to the deficiency diet, the formation of calculi was prevented. After the presence of calculi, which were too large to pass spontaneously from the kidney or bladder of the rats, had been demonstrated roentgenographically, an excess of vitamin A was added to the deficiency diet, and in every instance, provided the experimental animal survived, the calculus then underwent spontaneous solution and disappeared. This solution occurred in a comparatively shorter length of time when a co-existing urinary infection was not present. The calculi produced in this experimental work varied in diameter from 0.5 to 12 mm. They were light brown in color, spherical in shape, and they were composed chiefly of calcium phosphates with traces of carbonates. No oxalates or uric acid were present. A small amount of mucoid substance was noted also (Figs. 1 and 2).

After these researches, the question arose as to whether the chemical constituents of the calculi could be changed by altering the diet. As reported previously, a decrease in the phosphorus in the diet in relation to the calcium caused a complete reversal in the chemistry of the stone, and under these circumstances the principal constituent of the stones was then calcium carbonate. Traces of calcium and magnesium phosphate were found. Traces of oxalates were present, but no uric acid was found.

The question which then presented itself was: "Why can uric acid calculi not be produced in the white rat by further modifica-

tion of the diet?" The absence of uric acid in the calculi produced in the white rat may, of course, readily be explained by the fact that these animals possess the power of oxidizing approximately 80 per cent of the circulating purines to allantoin. Allantoin is much more soluble in water than uric acid and thus it never forms a constituent of the calculi in rats.

It has been stated that calculi have been produced experimentally only in white rats—a species quite remote phylogenetically from

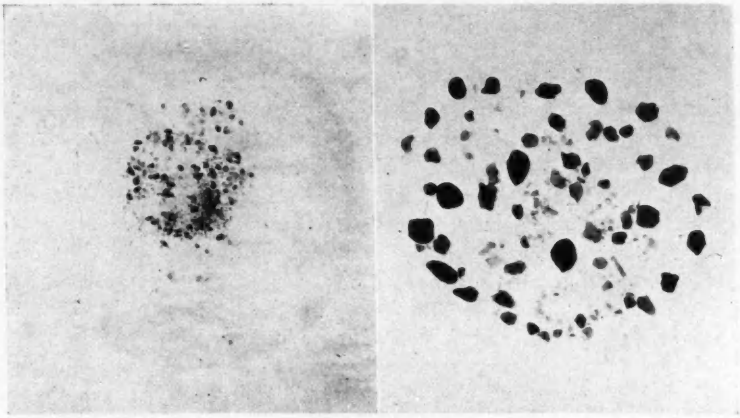

Fig. 1 *(left)*. Kidney stones removed from rat on vitamin A deficiency diet.
Fig. 2 *(right)*. Bladder stones removed from rat on vitamin A deficiency diet.

man. Therefore, a similar series of experiments with dogs has been in progress for the past year. In the dog, as in the rat, care must be taken to maintain a mild deficiency diet for a long period of time. If more than a moderate degree of vitamin A deficiency is continued, the animals die from pulmonary complications or from diarrhea—a disease which simulates distemper (Fhloring[5]). Thus, only a very mild degree of vitamin A deficiency is permitted for a long period. Such symptoms as loss of weight, xerophthalmia, and marked weakness of the legs should not occur.

A group of seven dogs has been maintained on the vitamin A deficiency diet for a period of eleven months. Recently, under

ether anesthesia, cystotomy was performed on each of four of these animals. Multiple stones were found in the bladders of three, and no stones or sand were noted in the fourth dog. One large stone which was too large to pass spontaneously was allowed to remain in the bladder of each of the three dogs and the bladder was closed by the usual technic. The dogs are now being fed a high vitamin A acid-ash diet in order that we may ascertain whether the stones will undergo solution.

Chemical analyses of the calculi removed from these dogs revealed that they were composed of ammonium and calcium phos-

Fig. 3. Stones removed from bladder of dog on vitamin A deficiency diet.

phate with small amounts of carbonates (Fig. 3). No urates or uric acid were present. Although this series of experiments is too small to warrant definite conclusions, at least we may infer that bladder calculi may be produced in dogs maintained on a mild vitamin A deficiency diet for a considerable period of time.

The possibility of producing calculi composed of uric acid and urates was then considered. It is well known that birds eliminate uric acid and that a greater part of the urea is converted into uric acid. Benedict and Behré[1] discovered the unique mechanisms of uric acid metabolism in pure bred Dalmatian dogs by which considerable uric acid is eliminated in the urine. Investigations are now in prog-

ress in our laboratories in an attempt to produce calculi in this animal. Emmett and Peacock[4] in 1923 learned from autopsy findings that avitaminosis in chicks was associated with the presence of urates in the kidneys and at times on the surface of the heart and spleen.

Cruickshank, Hart and Halpin[2] found kidney lesions in practically all chickens that died during their experiments with avitaminosis. The kidneys were pale and contained an accumulation of urates. Likewise Elvehjem and Neu[3] reported an elevation of the blood urea when the chicks were maintained on a diet deficient in vitamin A.

Therefore, we used the following diet in a series of experiments with twenty chickens:

58 parts ground white corn
25 parts wheat middlings (standard)
12 parts crude casein
1 part sodium chloride
1 part precipitated calcium carbonate
1 part precipitated calcium phosphate
2 parts dried yeast
water ad libidum

Irradiation was administered for twenty minutes three times a week. The control chickens were fed green yellow corn instead of white corn. In the test animals, the white corn was replaced occasionally by yellow corn in order to maintain only a slight deficiency for a long period of time. The growth curves and symptoms were indicative of mild deficiency. At intervals, the birds were allowed to progress to the stage in which they developed a staggering gait, ruffled feathers and weakness of the legs. No xerophthalmia was noted.

At autopsy (Figs. 4 and 5) five months later, the kidneys were found to be somewhat pale, urates and sand were present in the kidneys, and the ureters contained urates and small uric acid calculi. Hard concretions of uric acid were present in the cloaca. The blood uric acid in the controls averaged 5.1 mg. per hundred cubic centimeters of blood and after the birds studied had been on the deficiency diet for a period of five months, just prior to post mortem study, the blood urea averaged 14 mg. per hundred cubic centimeters of blood. In order to produce calculi similar to vesical stones, a colostomy has been performed in chickens thus diverting the fecal stream and utilizing the lower segment of the bowel and

the cloaca as a bladder. From this structure, small calculi can easily be removed for chemical examination which has shown that they were composed purely of uric acid and urates. A more detailed report regarding the histologic changes in the kidney will be reported later.

In conclusion, while an insufficient number of dogs and birds

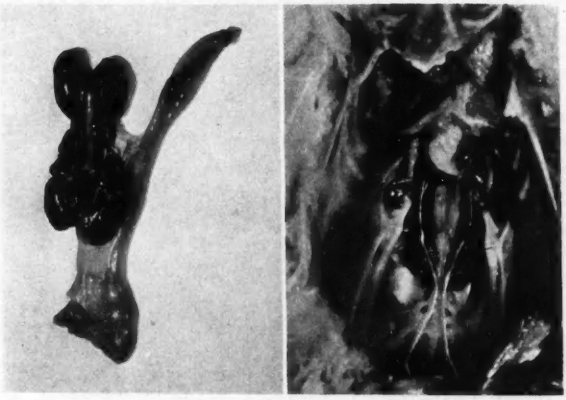

Fig. 4 *(left)*. Kidneys, ureters and cloaca of normal chicken.

Fig. 5 *(right)*. Kidneys, ureters and cloaca of chicken on vitamin A deficiency diet. Note the ureters, which are filled with urates and small uric acid calculi.

has been studied to warrant definite conclusions, the relationship between vitamin A deficiency and the formation of calculi seems probable and the mechanism probably is similar to that which occurs in the white rat.

REFERENCES

1. Benedict, S. R., and Behré, J. A.: The analysis of whole blood. III. Determination and distribution of uric acid. Jour. Biol. Chem., 92:161-169, 1931.
2. Cruickshank, E. M., Hart, E. B., and Halpin, J. C.: The vitamin A and vitamin D content of cod-liver meal. Poultry Sc., 7:9-16, 1927.
3. Elvehjem, C. A., and Neu, V. F.: Studies in vitamin A avitaminosis in the chick. Jour. Biol. Chem., 97:71-82, 1932.
4. Emmett, A. D., and Peacock, Gail: Does the chick require the fat-soluble vitamins? Jour. Biol. Chem., 56:679-693, 1923.
5. Fhloring: Personal communication.

6. HIGGINS, C. C.: The experimental production of urinary calculi. Jour. Urol., 29:157-185, (February) 1933.
7. HIGGINS, C. C.: The experimental production of urinary calculi in rats. Urol. and Cut. Rev., 38:33-39, (January) 1934.
8. HIGGINS, C. C.: Production and solution of urinary calculi. J. A. M. A., 104:1296-1299, (April 13) 1935.

DISCUSSION

DR. E. GRANVILLE CRABTREE (Boston, Mass.): It is probably rather dangerous to discuss Dr. Bryan's paper with all the advice that he has had from the important people of this Society.

I do want to mention one point in regard to his case and that is the proteus infection. At the time Dr. Higgins spoke in Boston this spring I was struggling with a patient who had a very alkaline urine in the only kidney which she had. The ureter had been transplanted eight years ago into her intestine because somebody previously had burned the base of her bladder and her rectum to the point of incontinence of those organs. After eight years of uneventful life, passing both urine and feces through this opening, she quickly developed obstruction of the lone kidney. Intravenous urography showed a dilated ureter and a dilated kidney pelvis with apparently good cortex renis.

I felt that I had to remove the stones, which I did, and rather to my surprise I found that the ureter was in active motility, showing, I thought, rather recent obstruction. I took out the stones and did a nephrostomy for more or less permanent drainage. Then I was left with the proteus infection, which failed to change the pH of the urine under any medication. I sent the patient home with the nephrostomy tube in place and have given her daily injections of mercurochrome. I am not a mercurochrome enthusiast because it usually hasn't served me well, but in this case it did. This patient now has an alkaline urine beginning at about 5 to 4.5 while on an acid ash diet and heavy doses of ammonium chloride. She is now using no medication except the acid ash diet. Her bacteria have disappeared and pH is just barely on the acid side. I don't know what will happen when I take out the tube because she has a connection to the intestine and I might pick up the infection again.

The suggestion as to the handling of the proteus infection I have had no other occasion to try, but it worked in that one case.

DR. ALEXANDER RANDALL (Philadelphia, Pa.): These four papers are intensely interesting, touching as they do on this omnipresent problem. As I see it, they separate into two definite fields.

On the one hand is the presentation of material which is getting us closer and closer to the cause of stone; on the other hand comes up the question of treatment. We are all familiar with the five outstanding theories as to why stones occur. Recently I have suggested the idea that they are all wrong and that they are all secondary causes. If we search for a primary cause for calcification to occur in the kidney pelvis we must add to it certain assumptions, certain stipulations, which have to be fulfilled. First of all we must create a reason why a stone crystallizes or why salts come out of the urine in crystal form. Again we must picture that starting as a tiny microscopic unit. We must picture some condition whereby that microscopic unit becomes static in the renal pelvis and is not washed out, and stipulate a definite period of time for that stone to grow to, let us say, macroscopic proportions. The lesion must be predominantly unilateral. When that is required there is only one thing I believe that would possibly fill that bill and that is a primary ulcer somewhere on the pelvic wall, a primary break in the mucous membrane which will allow crystallization to deposit on it. This, as we know, furthers crystallization, allows that crystallization to be static, can be unilateral, and allows time for growth.

It is hard to formulate a cause for such a lesion, for the simple reason that the pathology of the renal pelvis has not yet been written. On the other hand it is not difficult, especially in the light of a number of facts that have come out in this program this morning, to picture infection as being a very large factor; not the acute infection which we have heard about this morning in regard to carbuncle of the kidney, but low grade chronic infectious processes, such as cause metastatic infectious conditions elsewhere.

I think probably we would have to add to this phase of the picture a second possible cause for pelvic ulceration, *i.e.*, trophic changes, such as occur elsewhere. Thirdly, we include the lesions which now we do know come from a vitamin A deficiency diet. These epithelial changes, with which you are familiar, have been graphically described and are well recognized.

With such lesions we have a reason for a stone to start to grow and remain in an otherwise normal kidney pelvis. This group stands alone, and, as the lesions are primary pelvic pathology, so let us call the stones which are caused thereby *primary renal calculi.*

There necessarily must be a second grouping, and if we call the

first group the primary lesions (the primary stones) I should like to call the second group *secondary renal calculi,* because I believe that here the basic pathologic change is obstruction. Here, I believe, the pathologic changes follow the well-known picture of vesical calculus in bladder obstruction, and we do not have to postulate a great deal as to how and why a stone can and does start. This is already well understood and accepted, though we have been tardy in transporting this knowledge to the upper urinary tract.

One of the most important points brought out in Dr. Higgins' paper this morning is the necessity of clearing up our ideas regarding the varying chemistry of stone. Let us look at it today from the point of view that the type of stone that forms in a kidney is dependent entirely upon the supersaturation of a certain salt, at that time or that epoch. Dr. Higgins has been able, as he has just shown, to take the same group of animals and, by a dietary change, so change urinary concentration of certain salts as to make the diseased kidney, at his will, form first a phosphate stone and then a carbonate stone.

How clearly does this help us in understanding why we see laminated stones anywhere in the urinary tract? I have jokingly said that I think the time will come when we will look at a stone and say, "Look at this beautiful ring of oxalates: that was the spinach season"—supersaturation of a certain salt of the urine over a period of time and that type of precipitation. I think that is the most important thing that Dr. Higgins has brought to you this morning.

On the other hand is the problem in regard to the treatment of stones and especially in regard to dietary form of treatment. To abbreviate what I have in mind I should like to mention illustrative cases representing two different aspects of this form of therapy. The first is a man whom I first saw in 1929 when he was passing his twenty-second stone from his left kidney. He heard of a dietary method of treating stones and he came to me in 1935. He said, "Doctor, I have now passed fifty-six and the fifty-seventh one is right here." I have studied him from a great many angles. I have examined seven of his stones. They are all pure uric acid, and of large size. Three of them have come from his right kidney and fifty-four of them from the left kidney. His urograms and his pyelograms are practically normal, there is no obstruction of the slightest character, but this man voided in my office, on three suc-

ceeding days, urine with pH readings of 4.8, 5.1 and 4.9. There is the uric acid stone and there is the uric acid urine, and I cannot see how an acid ash diet will ever be used in this case.

Again, we have recently had a little girl in the ward who entered with an intense right renal colic, which broke with the passage of brick-dust urine. She evidently had a typical uric acid crystal shower. Subsequent urograms showed no obstruction. Voided urine had a pH of 4.6 and on subsequent days it changed to 5.1, 5.6 and she was discharged at 7.1 without medication.

I point out these factors as of value and interest in trying to cure uric acid stone by acidification. The man first mentioned was put on a diet of alkalinization and he is going along with very constant urine as far as I can tell at about a pH of 6.8 to 6.9.

That is one picture on therapy. This is another. I have been watching, since last October, under Dr. Higgins' supervision (I might say that because we are in constant touch with each other's work), a lawyer, a most intelligent chap, scared to death of surgery, who had a large stone in his left kidney. He is most coöperative. He has had monthly x-ray studies. He has had acidification to the maximum degree. He has been most attentive and willing simply because he did not wish to be operated upon. After getting the pH of his bladder urine rather consistently down to 5.4, 5.6, and finding consistently no progress shown on the x-ray plates, I catheterized his stone-bearing kidney, and whereas his bladder urine was pH 5.4, and his normal kidney urine was pH 4.8, his stone-bearing kidney urine was pH 7.9.

Another similar case is an intelligent druggist who is quite a chemist and who worked out his own pH. He went into the hospital for ten days to get on the diet, as Dr. Higgins likes his cases to be, and active acidification was attempted. I will abbreviate because when we stopped our efforts after two weeks he had gotten a pH of the bladder urine of only 6.5, but had a normal right kidney urine of 5.0, while over in his stone-bearing kidney it had remained 8.1.

Now, gentlemen, these two cases instruct us on another factor in regard to the dissolution of stone by dietary methods. The last case had a differential phenolsulphonephthalein test done. His stone-bearing kidney excreted 12 per cent after intravenous injection in a half hour's collection. His normal kidney excreted 31 per cent.

Phenosulphonephthalein is a foreign body put in the blood stream which normally is carried to the kidneys and which the kidneys recognize as a foreign body and eliminate. We use the red color of that elimination for colorimetric determination, and, because we can so read it, we call it a functional test. It is nothing more nor less than what good and bad kidneys do with a foreign body. I am convinced that the same thing is true when we put hexylresorcinol or any one of our antiseptics into the system with the idea of treating an infected kidney. We get a high concentration in our good side and we get a minimum or low concentration where we are trying to get the maximum. I think the same thing will probably become a stumbling block to dissolving kidney stones by dietary measures because the extreme diet and the acidifying drugs are again nothing but excessive foreign bodies and the good kidney will take care of the overload, while the diseased kidney will stumble along with its reduced function, getting practically nowhere.

Dr. George R. Livermore (Memphis, Tenn.): May I ask a few questions? On some of the experiments that we did on white rats on the A and D deficiency vitamin diet we were impressed with the inflammation and exudative changes that took place in the urinary tract, and also in the external genitals of these rats. We figured that perhaps these would cause stasis which might play some part in the formation of stone. I should like to ask Dr. Higgins if any of the animals other than the rat denote this exfoliation and cornification of epithelium and inflammatory changes that took place in the urinary tract of many of our animals.

Dr. Bryan's patient had a large kidney stone. I should like to show one in a woman who was seventy-two years of age, who came to me first with a stone, probably a half-inch in diameter, in her right kidney. (Slide) Within six months the stone filled the pelvis and calices of the right kidney, and one had formed and nearly filled the pelvis of the left kidney. In the succeeding six or eight months these stones had continued to grow until there were enormous stones filling pelves and calices with marked destruction of kidney tissue. This woman was able to do her housework up to within a month or two before her death. She was seventy-two when I saw her. She went for a period of over four and one-half years with those stones gradually increasing. They were phosphatic and the urine was alkaline. We had her on a diet and urotropin

and acid sodium phosphate the entire time and were irrigating the kidneys, but the stones continued to grow regardless of what was done.

DR. GILBERT J. THOMAS (Minneapolis, Minn.): May I ask if Dr. Higgins, when he closes his discussion, will tell us something about the result of the examination of the kidneys in these animals in which autopsy was made and had stones in the pelvis and urine? I should like to know what the kidneys showed.

DR. IRA B. SISK (Madison, Wisc.): I would like to show two slides merely for academic interest.

(Slide) This man consulted me in 1921 and had only one kidney. He was forty years of age. The other kidney had been removed at the age of twenty for some reason. He had this stone in the remaining kidney. (Slide) I didn't see him again for nine years and three months, when he was about to be operated upon for intestinal obstruction and insisted upon seeing me before the operation. (Slide) His symptoms then were due to uremia instead of intestinal obstruction. The stone had not changed in size and he had been able to work most of the time.

DR. CHARLES C. HIGGINS (Cleveland, Ohio): As Dr. Randall has stated, in addition to supersaturation, other factors must be present to account for the formation of calculi. For instance, Holmes and Coplan have reported three cases of complete urinary obstruction, in which the bladder was filled completely with phosphates, but no calculi were present. It is necessary, therefore, to have some insoluble cement substance that acts as a framework for the formation of calculi. As a matter of fact, a stone can be immersed in a certain chemical solution which will dissolve out the salts, and a network similar to a sponge will remain. Another solution can be used which dissolves the framework of the calculus and leaves nothing but the precipitate behind. My idea at this time in regard to the nature of the formation of calculi is similar to that presented by Dr. Randall. I believe that if a calculus is to be produced in a kidney, a lesion in the mucosa is essential. If the kidney pelvis just above the lower calix in a dog is traumatized, and Streptococci then are injected beneath the mucosa, an ulceration will occur. If the urine is rendered strongly alkaline for a period of time,

a deposit of phosphates will be found on the denuded area in the kidney pelvis. This may pass either down the ureter and be eliminated in the urine, or drop into the lower calix of the kidney and produce a calculus. However, the original nucleus of the stone forms on the point of ulceration.

A somewhat similar experiment may be performed in the bladder of the dog. Cystoscopic examination is made of the bladder of a female dog and the region in front of the trigone is traumatized every few days with a wire which produces an ulceration; then the urine is rendered strongly alkaline. After this a deposition of phosphates occurs on the ulcerated area, and the salts adhere to the fibrin that exudes at this point. This small mass of sand and fibrin may be dislodged into the base of the bladder, and, if it is too large to pass spontaneously, it will continue to enlarge if alkalinity of the urine is maintained.

In experimental work with deficiency in vitamin A, keratinization of the epithelium in the bladder, ureter and kidney pelves occurs. This may progress to desquamation and points of ulceration in the kidney pelves, and this is noted in the dog as well as in the white rat. At the point of ulceration there will be noticed a definite adherence of the sediment which has a somewhat similar appearance to that of the bladder in case of encrusted cystitis.

One clinical test, which I believe is extremely important in the management of patients with urinary calculi and which we use routinely, is the Jeans' test. By the use of this test, one may determine whether or not moderate deficiency in vitamin A is present. Dr. Jeans, at the University of Iowa, has shown that approximately 20 per cent of the children who enter the dispensary for examination and treatment have a definite vitamin A deficiency.

The management of patients with a proteus infection in the kidney is an extremely difficult problem. During the past few months, I have seen nine cases of bilateral renal calculi associated with proteus infections, in which I could not reduce the pH of the urine to the acid side by the use of the acid-ash diet even when very large doses of the acidifying agent were administered by mouth. All these patients have been treated elsewhere with the ketogenic diet, and again a satisfactory result could not be secured. Three of these patients, however, after they had followed the diet for a period of

three and one-half months, were found to be free from the proteus infection.

The point emphasized by Dr. Randall is extremely important in the medical management of urinary lithiasis. I also feel that it is extremely important that a cystoscopic examination be performed and specimens of urine should be collected from each kidney for a pH determination. In cases in which the calculus is unilateral in type, I have noted frequently that the pH of the urine from the kidney containing the stone was from 7.2 to 8, and triple phosphate crystals were found in the specimen, while the pH of the urine from the kidney free from calculi was on the acid side and varied from 4.2 to 6. In these cases, the bladder urine frequently was acid. This is due to the fact that the kidney which was free from pathologic changes was eliminating a larger amount of urine which was strongly acid. Therefore, the pH of the bladder urine in such cases does not represent a true estimation of the pH of the urine from the kidney containing the calculus. Even after the patient has followed the high vitamin A acid-ash diet, I frequently recheck the pH of the urine from each kidney. Microscopically, the kidneys of chickens that have extreme avitaminosis show a marked degree of nephrosis. In my experimental work, however, only a mild degree of vitamin A deficiency is permitted to occur. The pathologic findings in the kidneys of white rats depend entirely upon the length of time they have been maintained on the deficiency diet, the degree of infection present, and the location of the calculus which has been produced experimentally. There usually is some evidence of cloudy swelling, and, in cases of marked infection, pyonephrosis or pyelonephritis may be present. Keratinization of the epithelium involves the kidney pelves, the ureter, the bladder, and, in the female, the vagina, and, as has been shown by the group in Toronto, it also involves the pulmonary tree.

DR. GILBERT J. THOMAS (Minneapolis, Minn.): There is no stone formation in the tubules?

DR. CHARLES C. HIGGINS (Cleveland, Ohio): There is no evidence of calculus formation in the tubules; however, you can produce calcification in the tubules by the continued injection of parahormone, and in the arteries by the prolonged use of viosterol.

LATE EFFECTS OF VARIOUS TYPES OF TRAUMA TO THE KIDNEY

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The occurrence of injury to the kidney from physical force presents a problem which may tax the diagnostic experience and acumen of the surgeon to the utmost. The steady rise in automobile accidents throughout the country has led to a corresponding increase of kidney injuries which is reflected in the literature by several reports of extensive series of such cases by Schenck, Osgood and Campbell, and Austin Wood. In these reports the physical mechanism of the injury and difficulties in diagnosis and the possibility of concomitant injury to other structures have been reported in detail. The methods of combating shock, which is present in a high percentage of acute injuries, and the points upon which the surgeon's choice of operative or expectant treatment is based, are discussed in detail. In most of the series of case reports, the discussion of the indications for treatment are based entirely on the extent of the injuries received and little emphasis is placed on the late result of such injuries to the kidney itself or to its surrounding structures. This is naturally the case as the largest series of cases are seen in busy metropolitan hospitals in an active accident service in which a follow-up of the late results is practically impossible. Several series of gunshot wounds of the kidney were reported during the late war, but here again the cases have been detailed only with emphasis on the treatment of acute injury and no information is available as to the remote effect of these injuries on the kidney. The exigencies of the medical service during those days and the fact that such patients who recovered from their injuries were of necessity passed through numerous hospitals, would make a follow-up study of the late effects of the injuries extremely difficult to carry out.

During the past few years we have had an opportunity to observe a series of cases in which definite pathologic changes could be demonstrated clinically, in all of which there was a previous history of

more or less severe injury to the kidney and the late results of the injuries in many of our cases have been of such a serious nature that it has seemed advisable to emphasize this aspect of the problem. After a consideration of the series of cases which has been studied, it would seem that some at least of the serious after-effects which have been observed might have been prevented by better surgical methods, instituted either shortly after the injury had been received or at a later period when the patient's general condition would permit of more active methods.

The tendency toward conservatism in the treatment of injuries of the kidney can be readily understood and there is no doubt that in many of the less severe injuries, expectant treatment may be the best choice and may not be followed by any appreciable damage to the kidney and its surrounding structure which can be demonstrated at a later date. The surgeon who attends the case is preoccupied at first by combating the shock, which is usually present and if he is successful in tiding the patient over this critical period, and avoiding operative interference, it is only natural, as the patient's condition improves, and signs of active bleeding have ceased, that he should consider that he has successfully brought the patient through the crisis, and that by his judgment an operation has been avoided. Also, from the patient's standpoint, it is difficult to understand why, after he has been carried through the stage of acute injury, that at a later date when he may feel himself well on the road to convalescence and complete recovery, operative intervention is advised.

To understand the production of persistent changes in the kidney itself, or in its surrounding structures, it is necessary to visualize the possible immediate effects of traumatism to the kidney. Küster has studied the mechanics of the problem and by his experiments has demonstrated that the kidney filled with blood may be compared to a body of fluid under hydraulic tension so that upon the reception of an injury the "force exerted upon any part of the fluid is transmitted equally in all directions throughout the mass." The possibility of a crushing injury directed through the kidney against the bodies or transverse processes of the vertebræ and ribs is, of course, self-evident.

For practical considerations three types of injuries to the kidney may be inflicted which will lead to persistent after-effects.

(a) Injuries to the cortex, with rupture of the true capsule, in which more or less extensive extravasation of blood and urine may occur in the perirenal tissues. While undoubtedly small extravasations may be readily and completely absorbed, in more extensive cases, the hematoma thus formed is of such an extent that it will not resolve and will become encysted in time. The precipitation of the calcium in the blood clots, often combined to some extent at least with the urinary salts, may lead to thickening and calcification in the wall of the cyst. The size of the cyst and its adherence to

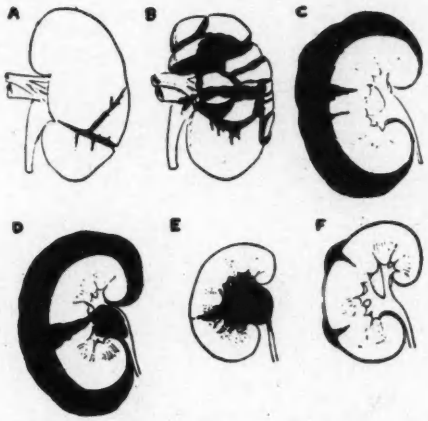

Fig. 1. The more common types of traumatic injury of the kidney. Reproduced from Osgood and Campbell, in Lewis' Practice of Surgery.

contiguous structures may lead to grave disability. The destruction of renal parenchyma may lead to permanent loss of function. The presence of a calcified cyst closely adherent to the capsule of the kidney may lead to further reduction of function through pressure atrophy.

(b) The parenchyma of the kidney may be torn into the calices or pelvis. In healing, the calices or pelvis may be greatly distorted by scar tissue, causing eventually hydronephrosis, dilatation and distortion or even obilteration of a calix, and during the period when the pelvis is distended with blood clot and hence is draining poorly, urinary salts may be deposited on a portion of the clot and

lead to calculus formation. In this type of injury again considerable distortion by scar tissue may result with subsequent permanent diminution of function.

(c) Injuries to the pelvis, or especially the upper portion of the ureter. If the tear is incomplete, subsequent cicatrization may lead to obstruction and hydronephrosis. If the ureter is completely torn across, at the time of injury, the kidney will eventually be completely destroyed. However, of course, there will probably be an extensive peripelvic extravasation of blood and urine.

The accompanying illustration from Osgood and Campbell (Fig. 1) will help to visualize the main types of kidney injury which may be inflicted, but two additional diagrams should be included: one, to show injuries of the vascular pedicle, and the other to show injuries of the pelvis and ureter. In Part *A* tears have been inflicted in the parenchyma with rupture of the true capsule and little or no extravasation. Such an injury might in all probability heal cleanly without demonstrable after-effects, provided that the pelvis or calices had not been too badly torn. In *B* multiple complete ruptures of the kidney have been inflicted and one would expect extensive perirenal extravasation. If the patient did not die of immediate hemorrhage and if operation were not undertaken the kidney would be completely destroyed and would finally be represented by an atrophic mass of scar tissue enclosed in a cyst, the walls of which would later become calcified. In *C* the cortex and capsule have been ruptured, but the injury has not extended into the pelvis or calices. Bleeding would probably stop when compression of the perirenal hematoma reached an appreciable degree. The injury of the kidney cortex would probably heal with minimal scar tissue formation. If the perirenal hematoma were very extensive it would probably result ultimately in the formation of a calcified cyst adherent to the kidney and distortion of this structure by pressure. In *D* the capsule and parenchyma of the kidney have been ruptured into the pelvis. Here again a perirenal hematoma would be formed which might result in a persistent calcified cyst. The pelvis has been torn and during the cicatrization might lead to extensive distortion by scar tissue with resulting hydronephrosis. In addition, urinary salts might deposit on the blood clot present and lead to renal calculus. In *E* the parenchyma has been torn into the pelvis. The true capsule has not been ruptured and there will be no

perirenal hematoma. Here again the pelvis may be distorted by subsequent scar tissue formation and there is a possibility of stone formation. In *F* two ruptures have been inflicted in the cortex, but the true capsule has not been torn. The after-effect of such an injury would probably be minimal and extravasation under the unruptured capsule would in all probability produce so much pressure that the bleeding from the tear in the cortex would soon stop. Such an extravasation would probably be easily re-absorbed. There is a possibility that a small cyst might persist.

Tearing injuries of the vascular pedicle usually result in death from hemorrhage. If the patient should survive such an injury the kidney would, of course, be necrotic and surrounded by a large perirenal hematoma. Ruptures of a previously normal pelvis would be extremely rare and it is difficult to understand how such an injury could be received without extensive kidney damage. However, in cases of primary hydronephrosis, rupture of the distended pelvis has been frequently reported. Such an injury would lead to extravasation of urine mostly about the kidney and the resulting scar tissue would probably further distort the hydronephrosis and hasten eventual complete destruction of the kidney. The ureteral wall may be crushed to such an extent that subsequent cicatrization will lead to traumatic stricture and hydronephrosis. In such cases there would be little or no perirenal hematoma unless the kidney cortex had been injured and its capsule torn. Should the ureter be completely severed, there will result a perirenal extravasation of urine and, of course, subsequent cicatrization will result in complete destruction of the kidney.

Infection may complicate the picture at any time in any one of these injuries. Should a perirenal hematoma become infected, it will take on the characteristics of a perirenal abscess. The clotted blood is an excellent medium for the growth of microörganisms and the injury of the tissue through trauma or from the extravasation of urine would further enhance the virulence of the infection. If infection should supervene either through the blood stream or through a ureteral catheter in a pelvis which has been torn and is filled with a blood clot, a pyonephrosis with complete destruction of the kidney may easily develop, or the infection may simply tend further to distort and complicate scar tissue formation.

Distortion of the pelvis or calices will favor the persistence of

infection. On account of the interference with drainage and the production of dilated cavities, the changes in the wall of the pelvis or calices due to scar tissue as a result of the injury may also interfere with the natural resistant properties of the tissues.

Eisendrath has recently reported a case of stricture at the uretero-pelvic junction with resulting hydronephrosis, which he attributed to an accident twenty years previously, which was followed by severe pain and hematuria of two weeks' duration. The patient was treated conservatively and the symptoms disappeared. Eisendrath saw the patient after the kidney was transformed into a hydronephrotic sac, caused either by direct injury to the ureter or contracture of peri-ureteral scar tissue.

The importance of recognition of a perirenal hematoma following a suspected injury to the kidney has been emphasized by Warner. Hagner advises expectant treatment in kidney injuries, if the hemorrhage is diminishing in amount and there is no evident perirenal extravasation.

Kemm reports a most unusual case which illustrates the necessity of continuous observation in suspected kidney injuries, even though clinical improvement may proceed uneventfully. His patient suffered a severe crushing injury to the left lumbar region. Shock lasted for twenty-four hours and the patient was discharged from the hospital on the sixth day. He was re-admitted ten days later in good condition, but with marked swelling of the abdomen, which on examination was found to be due to a tightly encapsulated collection of fluid extending from the diaphragm to the pelvis on the left side. At operation about two liters of straw colored fluid were found surrounding the kidney, which had been completely divided at the junction of the upper and middle thirds. The history in this case is similar to Cases 5, 6, 8 and 10 of our series in which abdominal swelling was noted occurring some time subsequent to the accident. Had operation not been performed undoubtedly a large calcified cyst would have resulted.

The effect of infection on the subsequent course of the case has been emphasized by many writers. Infection of a perirenal hematoma is a serious complication and may lead to extension of the abscess thus formed in many directions along the lines of least resistance. Infection directly introduced into the kidney as in the case reported by Jeck is extremely dangerous as the devitalized tis-

sue resulting from the injury forms an excellent medium for the growth of organisms. Culver advises against early ureteral catheterization in dealing with kidney injuries on account of the danger of introducing infection, but when pain persists, following spontaneous recovery, he advises that pyelography be carried out to determine whether distortion of the pelvis and calices is present. Woodruff believes that the subsequent loss of functional ability depends upon the type of obstruction of the organ and particularly upon infection. He states that a study of those patients not subjected to nephrectomy who have recovered without the intervention of infection would surely prove that in ordinary cases of rupture of a kidney by far the major number of patients recover without any appreciable diminution in functional ability. If infection involves the parenchyma, pyelonephritis, pyonephrosis and renal calculus may develop. Backus reports a case of severe injury to the right lumbar region, followed by shock and hematuria. The patient recovered under expectant treatment and pyelograms taken one month and two months after the injury showed the gradual development of hydronephrosis with contracture at the ureteropelvic junction which he interpreted as a post-traumatic fibrosis. West states that after three or four days of conservative treatment in cases in which hematuria persists with tumefaction in the left lumbar region, exploratory operation should be done without further delay, in an effort to control the hemorrhage and prevent infection.

Beretervide believes that thickening of the capsule of the kidney associated with pain and diminution of renal function, the syndrome known as nephrosclerosis, occurs as a result of trauma. He reports a case of a man aged fifty-three who received a severe injury in the right lumbar region, with hematuria persisting for twenty days, pain in the injured side on walking and effort which persisted for a year and a half. Ureteral catheterization showed marked diminution in the function of the right kidney. He emphasizes the significance of this condition in the work of an industrial accident commission.

In the literature there are a few reports of the development of renal calculus following injury to the kidney. Boshamer emphasizes the importance of postraumatic calculus and mentions the fact that this condition is rarely mentioned in textbooks. He believes that a stone may form either by deposition of urinary salts

on a clot or about a piece of necrosed tissue. If associated injuries to the spine or long bones are present, the probability of stone formation is enhanced, as has been observed in injuries of this type. Dubner believes that in every true traumatic renal calculus a nucleus of blood coagulum should be demonstrable in the concrement. He emphasizes the frequent occurrence of renal calculi in traumatic transverse lesions of the spinal cord, but quite correctly does not regard them as true traumatic renal calculi. He reports a case of a patient, aged eighteen, who had a severe injury to the left flank. No definite history of hematuria could be obtained. Two years later he began to have severe pains in the left lumbar region at irregular intervals. X-ray examination at this time revealed no calculi, but microscopic blood was present in the urine. The pains continued at intervals and a year later x-ray plates revealed a calculus in the region of the right renal pelvis. The calculus was removed through a pyelotomy incision and the specimen consisted of two flat shells of calcification, inside of which an old blood clot was situated.

Bonar reported two cases of retroperitoneal hemorrhage. He describes the case of a woman aged thirty, whose left eye had been removed for "tubercular trouble" several years previously. She noticed pain in the right loin followed by a swelling on this side of the abdomen five months after a fall. At the time of the original accident she was not severely injured and no hematuria had occurred. An exploratory laparotomy was done which revealed a large retroperitoneal hemorrhage about the right kidney. A year later a right nephrectomy was done and the operative specimen showed the lower pole occupied by a melanotic sarcoma. This is the only case of retroperitoneal hemorrhage following trauma in which a tumor has later been found. In reviewing this case, however, it seems more probable that the melanotic sarcoma was secondary to a tumor of the eye and that the retroperitoneal hemorrhage occurred spontaneously from extension of the tumor through the capsule and that it bore no relation to the trauma which had occurred five months previously.

In the following series of cases, a short summary of each of which is given, definite pathologic changes could be demonstrated either on clinical examination or at operation which were definitely correlated to a previous injury to the kidney.

Case 1.—A. H., aged thirteen, was admitted to the hospital July 25, 1933, a few hours after the right side was injured by a fall from a horse. Hematuria persisted ten days; severe pain for the first few days. The patient was discharged August 10, 1933, with urine clear and symptom-free. Intravenous urogram four months later (November 6, 1933) showed hydronephrosis of the upper calices, and marked distortion of the lower calix (Fig. 2).

Comment: A rupture through the kidney substance, probably into the pelvis, resulted from the accident and in the process of scar tissue

Fig. 2. Case 1. Intravenous urogram four months after the accident. There is moderate dilatation of the upper and middle calices of the right kidney and marked distortion and irregularity of the lower calix.

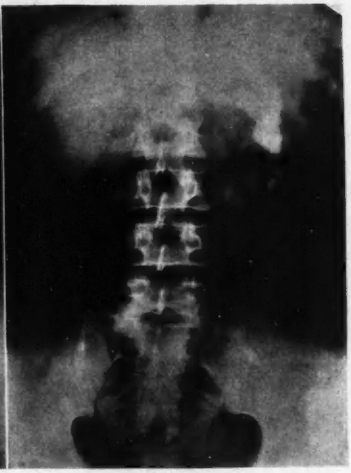

Fig. 3. Case 2. A large stone fills a portion of the pelvis and greatly dilated upper calix. Numerous small stones are present in the middle and lower calices.

formation, there has been distortion of the pelvis and calices. While the patient is free from symptoms at present, it is probable that the hydronephrosis will progress and stone formation is a distinct possibility.

Case 2.—L. M., aged twenty-seven, was admitted to the hospital October 4, 1929, complaining of dull pain in the left side and cloudy urine. His left side was injured fifteen years ago by a fall. He had severe pain for three days, hematuria for ten days. Plain x-ray (Fig. 3) showed a large stone filling the upper portion of the left kidney and numerous small stones in the lower calix. Ureteral cathe-

terization showed marked diminution of function of the left kidney. Pyelogram (Fig. 4) showed marked hydronephrosis and especially distortion of the upper calix. On account of the presence of stone, reduced function and the markedly distorted pelvis, nephrectomy was done on November 8, 1929.

Comment: The stone almost certainly arose as a result of the kidney injury. It seems possible that had the kidney been exposed at the

Fig. 4. A large dilatation and distortion of the upper calix with moderate dilatation and clubbing of the middle and lower calix. Pelvis and upper ureter are moderately dilated.

Fig. 5. Case 3. A small stone apparently in the lower calix of the left kidney.

time of the accident with repair of the injury, and especially drainage of the pelvis by nephrostomy, the extensive distortion which later necessitated nephrectomy might have been avoided.

Case 3.—A. R., aged fifty-five, was admitted to the hospital October, 1929, on account of attacks of pain in the left lumbar region. The patient had received a severe injury to the left lumbar region in a motor boat accident six years previously. Hematuria appeared after the accident and persisted for three weeks. One year later a calculus was removed through a nephrotomy incision. X-ray (Fig. 5) showed a small stone in lower calix and pyelogram showed definite constriction at the ureteropelvic junction, with early hydronephrosis.

Comment: It seems possible that had the kidney been exposed, fol-

lowing the accident, and the pelvis washed free of blood clots and adequately drained, the subsequent stone formation and operation might have been prevented. The stone which is now present will probably grow steadily and necessitate another operation, possibly nephrectomy. The stricture at the ureteropelvic junction demonstrated by pyelographic study, was probably caused by scar tissue formation resulting either from direct injury or as a result of perirenal hemorrhage.

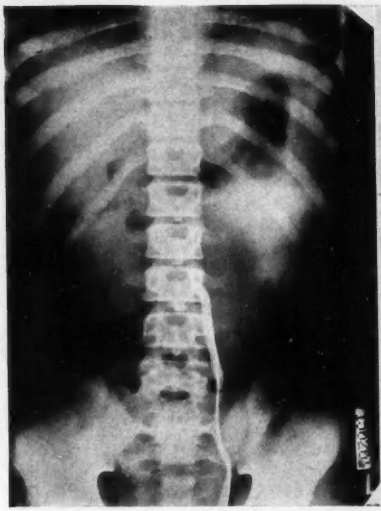

Fig. 6. Case 4. Retrograde pyelogram showing marked dilatation and incomplete filling of the pelvis of the left kidney. The upper ureter is also dilated and is pushed toward the midline.

Fig. 7. Case 4. Operative specimen. Secreting tissue of the left kidney has been practically completely destroyed by hydronephrosis. The pelvis is markedly dilated and an old puckered scar is present on its internal and external surfaces. There is a marked kinking and definite obstruction at the ureteropelvic junction.

Case 4.—D. C. entered the hospital April 7, 1935, on account of recurrent attacks of severe pain in the left lumbar region. The patient fell from a tree in September, 1934, injurying the left lumbar region. He suffered pain for a few days and blood was present in the urine for three weeks. A pyelogram (Fig. 6) showed an enormous hydronephrosis with marked distortion and incomplete filling. On account of the fact that the kidney was functionless, a nephrectomy was done (W. W. B.). The operative specimen (Fig. 7) showed an enormous

hydronephrosis with almost complete destruction of secreting tissue. A marked kinking and obstruction was demonstrable at the ureteropelvic junction. On both the external and internal aspects of the pelvis there is a large well-healed puckered scar. It seems probable that a symptomless primary hydronephrosis was present at the time of the accident, as a result of which the wall of the distended pelvis was ruptured. It would be difficult to conceive of such an injury to a normal pelvis, without extensive destruction of the lower pole or midportion of the kidney.

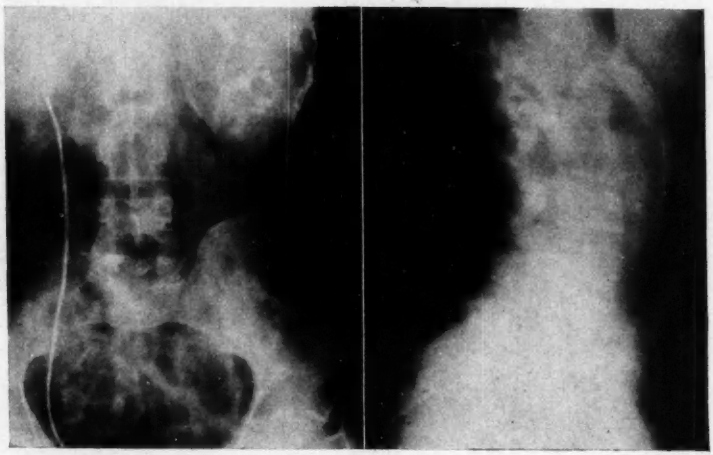

Fig. 8. Case 5. Stereoscopic left pyelogram. The pelvis is well filled. Calices cup-shaped and normal. No dilatation or other abnormality of the pelvis. In the stereoscope the cyst can be seen lying in front of and in close approximation to the kidney.

Fig. 9. Case 5. Lateral view of pyelogram showing the close approximation of the cyst to the anterior surface of the kidney.

Comment: If exploration had been made in this case soon after the injury, it might have been possible to repair the tear in the pelvis and correct the obstruction at the ureteropelvic junction by an appropriate plastic procedure and, with the institution of drainage, to save the kidney. It would have depended, however, upon the findings at exploration and the amount of undamaged kidney tissue which was present.

Case 5.—S. R. T., patient of Dr. Hugh H. Young, was admitted to the hospital March, 1924, at which time a diagnosis of tuberculosis of the seminal tract was made. A radical excision of the seminal tract

was done by Dr. Young. The patient was seen again in April, 1926, in excellent condition, with incision well healed. He complained of dull pain in the region of the left kidney. On further questioning at this time, it was brought out that thirty years previously he had been run over by a wagon, the wheels passing over the left side. He did not remember the presence of blood in the urine, but a gradual swelling of the abdomen occurred, becoming so prominent that six months later a large amount of fluid was drawn out by a needle on two occasions. For the past few years he had noted a dull pain in the left

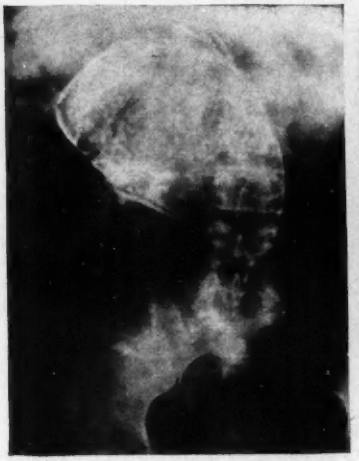

Fig. 10. Case 6. Large multilocular calcified cyst occupying the entire right side of the abdominal cavity.

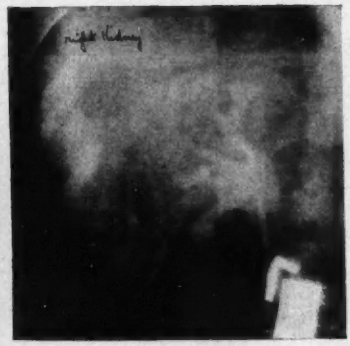

Fig. 11. Case 7. Stereoscopic right pyelogram. Pelvis is well filled, the calices are normal and there is no dilatation or other abnormalities of the pelvis. In the stereoscopic view, the cyst is seen to lie in close approximation to the anterior surface and convex border of the kidney.

side of the abdomen and left lumbar region. Stereoscopic x-ray showed a large calcified cyst over the left kidney, apparently closely adherent to its anterior surface. Cystoscopic examination, ureteral catheterization and pyelograms (Figs. 8 and 9) showed no evidence of kidney disease. The kidney was exposed through an extraperitoneal incision by Dr. Young and a large calcified cyst was found adherent to a scar on the anterior surface of the kidney. On account of the dense scar tissue which bound the cyst to the peritoneum and intraperitoneal viscera, excision was impossible.

Comment: It seems probable that the extensive rupture of the kidney occurred at the time of the accident with resulting perirenal extravasation. A large portion of the fluid resulting from the perirenal extravasation was subsequently removed by tapping, but the walls of

the remaining portions of the hematoma became calcified as a result of the changes which took place in the disintegrating blood clot.

Case 6.—H. B., patient of Dr. A. E. Goldstein, was admitted to Sinai Hospital, February 1926, on account of disability from a large mass in the right side of the abdomen. Twenty-five years previously the patient had been kicked by a horse in the right flank. He was rendered unconscious for some hours and did not remember whether blood was present in the urine. Several days later a mass appeared in the right flank which slowly increased in size. For the past six months it had caused great discomfort and incapacity. Plain x-ray (Fig. 10) showed an enormous multilocular calcified cyst occupying the entire right half of the abdominal cavity and extending down below the brim of the pelvis. On account of the extreme disability and pain an attempt to remove the cyst was made. The operative procedure resulted in shock from which the patient failed to rally.

Comment: It is quite evident that had operation been carried out at a time after injury when the patient's condition would permit, the extravasation could have been drained, the blood clot removed and the subsequent formation of this enormous multilocular cyst could have been prevented.

Case 7.—G. K., aged thirty-eight, patient of Dr. Hugh H. Young, entered the hospital October, 1923, on account of dull pain in the region of the right kidney. Four years previously he had been severely injured about the back and head in an automobile accident. His injuries necessitated hospitalization of several months, during the first few weeks of which blood was present in the urine. Stereoscopic x-ray (Fig. 11) showed a large calcified cyst intimately attached to the anterior surface of the right kidney. On account of the fact that the cyst was causing no severe disability, and on account of the technical difficulties encountered in the previous case, no treatment was advised.

Comment: If the kidney had been explored at a time following the accident when the patient's general condition was satisfactory, the perirenal clots could have been evacuated with drainage, and the subsequent cyst formation would have been prevented.

Case 8.—S. M. S., aged thirty-one, patient of Dr. Hugh H. Young, was admitted to the hospital March, 1929, on account of a mass in the left side of the abdomen and numbness of the left leg. Twenty-one years previously he had been struck in the left side by a sled and was rendered unconscious for a few hours and confined to bed for several weeks, but did not remember that blood was present in the urine. A large mass gradually developed in the left side of the abdomen and two and a half years before admission a large amount of fluid was withdrawn by aspiration. Stereoscopic x-ray (Fig. 12) showed a huge multilocular calcified cyst occupying the entire left side of the abdomen and causing marked scoliosis. Ureteral catheterization showed no

function from the left kidney and on pyelography it was impossible to introduce the medium into the pelvis. It was evident that the left kidney had been completely destroyed. On account of the extreme difficulty and pain caused by the cyst, it was exposed extraperitoneally by Dr. Young, and as much of the walls as possible excised, the remaining portions of the walls crushed in and drainage instituted in such a manner as to marsupialize the remainder of the cavity (Fig. 13).

Fig. 12. Case 8. Large calcified cyst with irregular margins occupying the entire left side of abdomen. Only at the upper left border can the cyst margin be definitely made out. The calcification in this case is not so pronounced as in the preceding instances. The huge size of the cyst has caused marked scoliosis.

Fig. 13. Case 8. Postero-anterior view, twenty months postoperative. Outlines of cyst can no longer be made out. Indefinite calcification is seen in the left side of the abdomen with marked accentuation of calcification in linear areas as though there had been approximation of the walls of the cyst with intensification of the shadow.

Comment: The kidney probably suffered a comminuted injury at the time of the acident, resulting in enormous perirenal extravasation and subsequent complete destruction of all kidney tissue. The subsequent cyst formation could have been prevented by exposure of the kidney following the accident. It is probable that the kidney would have been found so badly injured that nephrectomy would have been necessary, but this procedure, followed by evacuation of perirenal clots and institution of adequate drainage, would have prevented the subsequent formation of this huge cyst.

Case 9.—J. S., aged sixty-three, patient of Dr. Hugh H. Young, en-

tered the hospital October, 1930, on account of obstruction to urination. A cautery punch was done with complete relief of symptoms. The patient returned in February, 1931, complaining of burning sensation in the hip. On further questioning it was brought out that two years previously he had fallen from a scaffold and had received a severe injury across the back. He was unconscious for a short time and was incapacitated for four weeks, but at no time was there any blood

Fig. 14. Case 9. A small calcified cyst with well defined margins is seen lying in proximity to the upper pole and convex border of the right kidney.

Fig. 15. Case 10. A large clearly outlined calcified cyst occupying the whole right side of the abdominal cavity. The typical irregular calcification is much more pronounced in the upper portion of the cyst.

in the urine. Stereoscopic x-ray (Fig. 14) showed a small calcified cyst attached to the upper pole of the right kidney. On account of the absence of symptoms, no treatment was advised.

Comment: It seems safe to infer from the history that a cortical rupture of the upper pole of the kidney not involving the pelvis was incurred at the time of the accident, and the comparatively small extravasation of blood resulted subsequently in the formation of a small calcified cyst. It is evident that a cortical injury tearing through the capsule, but not involving the pelvis, might not be accompanied by hematuria, but the resulting extravasation might later lead to the formation of a calcified cyst.

Case 10.—J. C., aged twenty-one, was seen by Dr. C. A. Waters at at the U. S. Marine Hospital, Baltimore, Maryland, on account of ab-

dominal pain and gastro-intestinal symptoms. Fifteen years previously the patient was struck by an automobile and severely injured. Exploratory laparotomy was done on the day of the accident, but no injury of abdominal viscera was found and there was no free blood in the peritoneal cavity. The patient did not remember whether blood was present in the urine. He made an uneventful recovery from the operation, but subsequently a large mass became palpable in the right

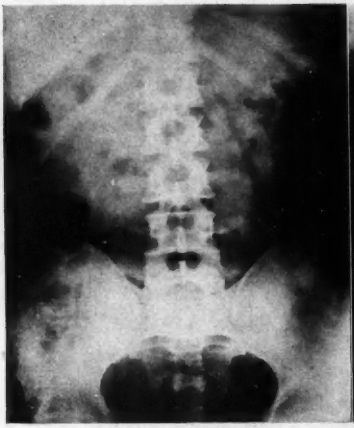

Fig. 16. Case 11. Complete obliteration of the outline of the right kidney and obliteration of the psoas shadow.

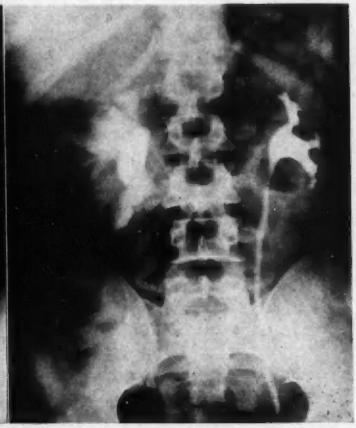

Fig. 17. Case 11. Pyelogram showing marked distortion of the pelvis with obliteration of the normal shadows of the calices. Apparently there has been extravasation of pyelographic medium through a transverse rupture at the junction of the upper and middle third of the kidney. There is a large hematoma under the capsule, surrounding the lower pole of the kidney. The pelvis is markedly dilated and distorted and there is apparently some extravasation of the opaque medium at the region of the ureteropelvic junction.

side of the abdomen. Stereoscopic x-ray (Fig. 15) showed a large calcified cyst closely adherent to the right kidney.

Comment: The patient's general condition at the time of the laparotomy apparently did not permit of careful examination of the kidney region. If the presence of a perirenal hematoma had been discovered then evacuation of the blood clots through a lumbar incision and adequate drainage would have prevented the development of this cyst.

Case 11.—S., patient of Dr. Austin Wood, was admitted to the hospital May 25, 1935, on account of severe pain in the right lumbar region. On April 26, he was thrown from an automobile and received a severe blow in the right epigastrium. He suffered severe pain but was able to walk home. Fresh blood was noted in the urine and persisted for three days, gradually clearing up. On May 8, pain had almost completely disappeared, and the urine was only faintly blood tinged. Physical examination revealed an indefinite sense of resistance over

Fig. 18. Case 11. Operative specimen showing two complete ruptures through the kidney.

the right kidney, with tenderness, but no definite mass was felt. The urine contained masses of red cells, but no organisms. Plain x-ray (Fig. 16) showed complete obliteration of the outline of the right kidney and obliteration of the psoas shadow. On cystoscopic examination smoky urine could be seen coming from the right ureter. A No. 6 catheter was introduced a short distance up the right ureter, and pyelogram (Fig. 17) showed marked distortion of the pelvis and obliteration of the calices. An indefinite shadow extending toward the cortex suggested perirenal extravasation. The pelvis was markedly dilated and there was probably extravasation around the upper ureter and lower pole of the kidney. On account of the definite severe injury to

the kidney, immediate operation was advised, but the patient refused to enter the hospital. His improvement continued and the pain disappeared, and he resumed his duties as a traffic policeman. On May 25, he was admitted to the hospital in shock, suffering severe pain in the right lumbar region, and the urine was again grossly bloody. At operation by Dr. Wood a complete rupture of the kidney was found (Fig. 18) at about the junction of the upper and middle thirds with extensive comminution. An extensive perirenal clot was found and

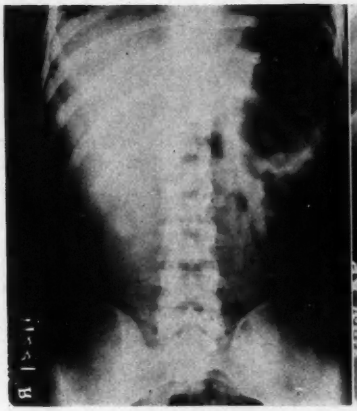

Fig. 19. Case 12. Plain x-ray immediately after the accident, showing obliteration of the outline of the right kidney and the right psoas muscle. Gas shadows in the region of the left kidney give a fictitious appearance of a pyelogram.

Fig. 20. Case 12. Intravenous urogram one month after the accident. No dye has been excreted in the right kidney. The outline of the kidney and the psoas muscle is still obliterated. The left kidney shows good excretion and the calices, pelvis and ureter are normal.

active fresh bleeding was encountered, probably coming from the torn vascular pedicle. The clots were evacuated, the pedicle ligated and the kidney removed.

Comment: It was quite evident from the plain x-ray that an extravasation of considerable degree was present about the right kidney. The pyelogram showed that an extensive comminuted injury of the kidney had been inflicted. Many writers have questioned the advisability of retrograde pyelography in cases of questionable kidney injury on account of the possibility of stirring up bleeding or especially of introducing infection. However, in this case no immediate reaction occurred, and valuable information was obtained as to the extent of the damage done, so that there was no question as to the advisability of

prompt operation. Had the patient consented to operation at this time, his general condition would have been much better than it was when the operation was actually performed. In addition, it seems probable that the operative procedure would have been much simpler because there would have been little or no fresh bleeding with which to contend.

Case 12.—K., aged twenty-eight, patient of Dr. Austin Wood, was struck with a piece of pipe in the right lumbar region March 22, 1935. He suffered pain and the urine showed gross hematuria. Plain x-ray

Fig. 21. Case 13. The outline of the right kidney is rather indefinite, but appears larger than normal. Opposite the transverse process of the second lumbar vertebra is a large stone, apparently in the pelvis of the kidney.

(Fig. 19) showed a shadow of the right kidney and the psoas muscle completely obliterated. Immediate operation was advised, but this recommendation was disregarded by the general surgeon and the patient was treated expectantly. He was re-admittd May 13, 1935. Examination revealed a large mass filling the entire right side of the abdomen, extending to the iliac crest. Intravenous urogram (Fig. 20) showed the obliteration of the shadow of the right kidney and the psoas muscle still present. There was no evidence of excretion of the dye by the right kidney. The pelvis of the left kidney was well outlined and was quite normal. Operation was performed by Dr. Wood, May 20, 1935.

Approximately 1,500 c.c. of extravasated blood and urine were evacuated from around the kidney. The organ was ruptured transversely and the lower pole completely separated. Nephrectomy was done. Convalescence was uneventful.

Case 13.—S. M., aged thirty-seven, patient of Dr. Austin Wood, was injured in an automobile accident in 1933. He was treated expectantly by the family physician for a few days, but was then admitted to the hospital on account of hematuria and pain in the right lumbar region. X-ray examination and intravenous urograms gave no important information. He was treated expectantly for two weeks and then discharged. He was seen by Dr. Wood on March 25, 1935, two years after the accident. He had had continuous dull pain in the right side since the accident and hematuria had recurred. Plain x-ray (Fig. 21) showed the outline of the right kidney rather indefinite. The kidney seemed somewhat larger than normal and opposite the transverse process of the second lumbar vertebræ, apparently in the pelvis, was the shadow of a rather large, soft stone, measuring about 4 x 2 cm.

SUMMARY

A series of thirteen cases is presented, in all of which clinical examination or operation has revealed definite pathologic changes either in the kidney or perirenal tissue. Previously all of these patients had been severely injured in the region of the kidney, at varying intervals of time before the patient was seen. The definite relationship of the trauma to the conditions described in these cases has been established, the conditions encountered varying from those causing minimal disability to those causing complete incapacity. In one patient the condition which arose as a result of the kidney injury was sufficient to cause death, and in most cases operation was necessary.

While it is not the purpose of this report to condemn conservative treatment of kidney injuries, yet the surgeon must be completely familiar with what changes may occur in the kidney or perirenal tissue as a late result of the injuries and should take the proper steps to prevent their development. All cases of suspected kidney injury should be subsequently studied with special reference to the demonstration of persistent perirenal extravasation. It should be easily recognized by a palpable mass, or the obliteration of the kidney outline and psoas shadow on roentgenologic examination. In all patients in whom hematuria has occurred as a result of an accident, an injury to the pelvis or calices should be suspect-

ed, and subsequent pyelographic studies should be carried out to be certain that distortion or particularly obstruction as a result of scar tissue formation which may lead to subsequent series damage to the kidney, has not occurred. In the emergency which exists, after any suspected injury to the kidney, in addition to the immediate responsibility, the surgeon should keep in mind a clear perspective of the ultimate changes which may result.

REFERENCES

BACKUS, H. S.: Traumatic rupture of kidney with symptomatology of acute abdomen, with case reports. New England Jour. Med., 211:563, (Sept. 27) 1934.

BERETERVIDE, J. J.: Renal insufficiency after trauma. Prensa Medica Argentina, 15:1438-1445, 1929.

BONAR, T. D. G.: Two cases of retroperitoneal hemorrhage. Lancet, 200:1078, 1921.

COLSTON, J. A. C.: Calcified cysts of the kidney. Bull. Johns Hopkins Hosp., 51:125, 1932.

CULVER, H.: Trauma as a factor in the production of certain urological conditions. Journal-Lancet, 50:379-382, (Aug. 15) 1930.

DELZELL, W. R., and HARRAH, F. W.: Eleven cases of ruptured kidney. Jour. Urol., 19:131-148, (Feb.) 1928.

DUBNER, I.: On the question of true traumatic formation of renal calculus. Deutsche med. Wchnschr., 57:851, (May 15) 1931.

EISENDRATH, D. N.: Ureteral stricture and hydronephrosis as late sequel to kidney injury. Jour. A. M. A., 104:1898, 1935.

GOLDSTEIN, A. E.: Personal communication.

JECK, H. S.: Stab wound of kidney, unusual complication. Jour. Urol., 17:449-452, (April) 1927.

KELLY, E. C.: Hematuria from a traumatic ruptured kidney. Illinois Med. Jour., 48:215, (Sept.) 1925.

KEMM, N.: Rupture of the kidney; delayed symptoms; operation; recovery. Brit. Med. Jour., 2:121, (Dec. 22), 1923.

KUSTER: Zur Enstehung der subcutanen Nierenzerreissungen und der Wanderniere. Arch. f. klin. Chirurgie, 50:676-686, 1895.

OSGOOD and CAMPBELL: Lewis' Practice of Surgery, Vol. 8, Chap. 5.

SCHENCK, G. F.: Traumatic rupture of the kidney. Calif. and West. Med., 40:341, 1934.

WARNER, F.: Traumatic injuries of the kidney. Boston. Med. and Surg. Jour., 176:740, (May 24) 1917.

WATERS, C. A.: Personal communication.

WEST, L. A.: Traumatic rupture of the kidney. Jour. Iowa State Med. Soc., 25:90, (Feb.) 1935.

WOODRUFF, STANLEY R.: The traumatized kidney: A study of the after-effects. Jour. Med. Soc. New Jersey, 27:208-211, (March) 1930.

WOOD, AUSTIN: Personal communication.

YOUNG, H. H.: Practice of Urology. Philadelphia: W. B. Saunders Co., 1926.

AN UNUSUAL ANOMALY OF THE KIDNEY

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Mrs. S., aged twenty-two, multipara, was admitted to the hospital August 15, 1930, with temperature 99.4, pulse 75, respiration 18, complaining of pain in the lower abdomen, nausea and vomiting, black spots before the eyes, lapses of consciousness with spasticity of muscles and weakness.

The above symptoms had begun ten months earlier during pregnancy with headache, decreased urine and epigastric pain. She became eclamptic and gave birth to a full term still-born babe a month before admission, following which nausea, vomiting and convulsions grew worse.

She had never been strong. The usual diseases of childhood were uncomplicated and followed by good recoveries. When two years old she had convulsions. At the age of eight she was kicked by a mule and sustained severe injury to the right side. She was told by her physician that the right kidney was dislocated.

The family history gave no record of tuberculosis, malignancy or congenital abnormalities.

The urine was cloudy, alkaline, specific gravity 1.011, albumin a trace, sugar none, urea 1 per cent, pus cells few, blood cells occasional, bacteria and triple phosphate crystals many.

The two-hour phthalein output was 64 per cent on one occasion and 71 per cent on another. The blood chemistry findings were as follows: Non-protein nitrogen 28.2 mgms., blood urea 10.2 mgms., creatinin 1.4 mgms. per 100 c.c.

Abdominal palpation detected an enlarged low right kidney which could not be replaced in the renal fossa.

Cystoscopy showed a mild degree of cystitis. The ureters admitted No. 6 catheters without difficulty. Of the collected urines the right contained occasional pus cells and a few epithelia, the left gave no indication of pus.

X-ray examination showed no calculi. Opaque catheters in the ureters showed the right to be somewhat tortuous, the tip of the catheter turned backwards at the level of the transverse process of the third lumbar vertebra. The left showed a normal course with its tip on the level with the transverse process of the second lumbar vertebra.

Fifteen cubic centimeters of urine were aspirated from the right kidney, following which 30 cubic centimeters of a 12.5 per cent solution of sodium iodide were injected and pyelograms taken in the hori-

zontal, the upright and the lateral positions (Fig. 1). The pyelogram taken in the upright position showed the kidney about 2 centimeters lower than in the prone position. The lateral pyelogram showed the kidney in about normal antero-posterior position. The ureter was dilated, particularly in the upper portion, the pelvis irregular with obliteration of calices.

A diagnosis of infected right hydronephrosis was made, and the patient was dismissed to be under the care of her local physician.

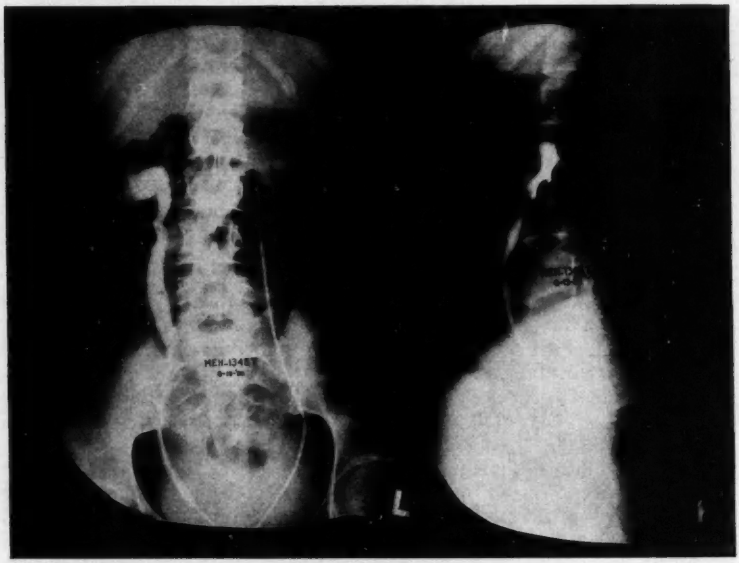

Fig. 1.

She was re-admited to the hospital three months later complaining of pain in the right abdomen and the lumbar region, but no urinary symptoms. She then stated that she had had pain and discomfort in the right side since eight years of age when she sustained the injury mentioned, and that she had been prevented from many activities because of aggravation of the pain.

Abdominal palpation confirmed the previous finding. There was no fever, no edema, and the blood pressure was 108/82.

The urine was of straw color and clear; reaction neutral; specific gravity 1.012 albumin a trace; sugar none; urea 0.9 per cent; hyaline casts occasional; pus cells few; blood cells occasional. The phthalein output was 51 per cent in two hours. Blood count: Hemoglobin 95

per cent; red blood cells 4,600,000; white blood cells 7,500; coagulation time 3¾ minutes.

Intravenous urograms showed a right hydronephrosis and dilated ureter, also a suggestion of calcification in the middle calix area. The left kidney appeared normal.

Three days later (November 24, 1930), upon a diagnosis of hydronephrosis due to ptosis with fixation, the kidney was exposed through a lumbar incision. Upon finding a lobulated, distorted kidney with a

Fig. 2.

cyst occupying the upper pole, nephrectomy was performed. Following operation the patient's immediate convalescence was uneventful, but upon her resuming activities the toxic symptoms recurred and she died uremic a year later.

The case is reported because of the unusual pathologic specimen found in the removed right kidney (Fig. 2). It was our first impression that the peculiar shape of the kidney was a result of fracture and partial separation of a portion of the organ. Further study argued against this assumption and in favor of an anomalous development.

The specimen, a flattened mass of kidney tissue, roughly oval in

form, measured 11.5 cm. by 8.5 cm., weighed 125 grams, and was covered by a continuous smooth capsule (Fig. 3).

At each extremity (pole) of the oval mass there was a narrow notch extending centripetally for a centimeter or more. The posterior surface presented a slightly raised, rolled margin which left the central area a shallow depression. The anterior surface presented similar features. In addition, the fissures and grooves were deeper, so that this surface was coarsely nodular.

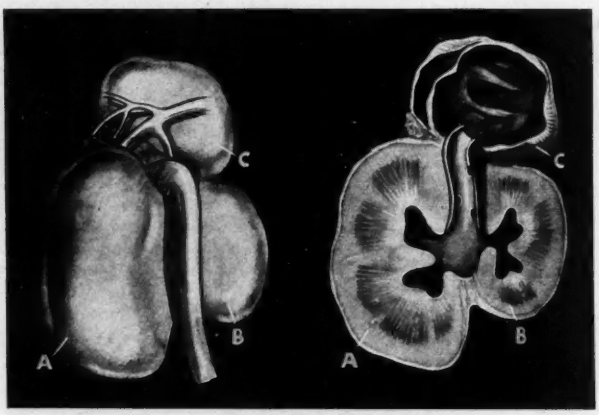

Fig. 3.

The notches and grooves divided the specimen into three reniform lobes (*A*, *B* and *C*). These measured in centimeters as follows:

	Length		Breadth		Thickness
A	7.6	x	4.4	x	3.5
B	5.1	x	2.9	x	2.8
C	5.2	x	3.9	x	3.2

Each lobe was supplied by a branch of the renal artery. This vessel presented no unusual features.

On the anterior aspect of the specimen and separating the upper pole of *A* from *C*, was a shallow depression, forming a rudimentary renal sinus. This contained a layer of loose, fibrous and adipose tissue which overlaid the isthmus of renal parenchyma, joining *A* to *C* on the posterior aspect. It was through this mass of loose tissue that a branch of the renal artery entered each of the three lobes. From the mesial extremity of this depression arose the ureter, which made a sharp U turn, coursing downward over the isthmus, joining *A* to *B*.

When the specimen was sectioned, the pelvis was found to be a short, cylindrical enlargement of the ureter. In its walls were six

apertures of quite similar diameter. Two of these opened into short closed sacs without papillæ, apparently rudimentary calices. Each of the remaining four apertures led into elongated, gradually expanding calices which surrounded appertaining papillæ. Two of these calices communicated with lobe *A*, a third with *B*, and the fourth with *C*.

The cortex and medulla of *A* were of normal thickness and presented the usual striations. The parenchyma of *B* presented similar features, except that the demarcation between these two zones was less distinct. The papillæ showed no flattening nor other distortions.

Lobe *C* was ellipsoidal in shape. Sectioning showed it to be a multilocular hydronephrotic sac. A thin cap of renal parenchyma covered each pole. The calix to this lobe divided, forming two rudimentary minor calices which ended blindly in the sac wall. This calix showed no evidence of dilatation. Its dimensions were equal to those calices found in *A* and *B*. The caps of renal parenchyma in *C* showed remnants of a cortex and a narrowed, thin and fibrotic medulla. Only a few glomeruli presented blood-filled capillaries. The majority of the glomeruli were fibrotic or hyaline. The cap of parenchyma passed gradually into the fibrous hyaline sac wall. There was no evidence of an active inflammatory reaction in these tissues.

Interpretation.—The unusual lobated form of this kidney was apparently the result of disturbed embryologic development. A survey of the embryology of the kidney reminds us that soon after the ureteric bud becomes a flat wedge-shaped structure, it begins the development of primitive collecting tubules. These primitive collecting tubules soon branch, giving rise to new tubular trees. This process continues until tubular trees of the tenth to the twelfth order are reached. A division of the metanephrogenic cap accompanies the formation of each tubular tree so that each branch possesses its individual cap of renal blastema. The tubules of the fifth order, with their branches, form a secondary tree, which later forms a secondary Malpighian pyramid. With the continued development of secondary trees, the metanephrogenic cap of adjacent secondary trees is soon forced into close apposition, being separated only by a very thin layer of connective tissue. These strips of connective tissue, with the metanephrogenic tissue of adjacent pyramids, form the columns of Bertini. In this specimen apparently, for some unknown reason, some of the branches of these secondary trees failed to receive or connect with a corresponding metanephrogenic cap. As a consequence of the failure of development of the metanephrogenic layers of adjacent pyramids, there resulted in this specimen these deep grooves, formed only of connective tissue, containing remnants of collecting tubules.

A second abnormality in this specimen was the faulty relations existing between the renal sinus and the kidney mass. In the normal kidney the plane of the renal sinus runs parallel to the long axis of the kidney. In this specimen the plane of the sinus was almost at right angles to the plane of the specimen. Inasmuch as flattening of

the primitive ureteric bud occurs early and shortly before the formation of secondary tubular trees, it is likely that a single cause may have produced both these abnormalities.

A third abnormality presented by this specimen was the hydronephrotic condition in lobe *C*. A study of the gross and microscopic features failed to reveal or suggest a cause for this condition. It was probably developmental.

REFERENCE

FELIX, W.: Development of the urinogenital organs. Manual of Human Embryology, vol. 2, 1912.

SECOND DAY, JUNE 7, 1935

CARCINOMA OF THE COLON INVOLVING THE BLADDER

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Disease of the colon sometimes affects the urinary bladder. The primary lesion is usually inflammatory or neoplastic and the portion of the bowel most commonly diseased is the sigmoid. The close relationship of these two structures and the marked mobility of this segment of the large bowel readily permit an extension of disease from one to the other.

Involvement of the bladder from the inflammatory processes of diverticulitis of the sigmoid is not unusual. Adhesions between the affected bowel and the bladder are said to be present in about 12 per cent of such cases, and actual fistulous communication between the two structures occurs in from 7 to 8 per cent.[6]

Similar conditions are encountered when the sigmoid is diseased by cancer. Narrowing of the bowel lumen from the presence of a tumor frequently results in chronic obstruction and the formation of an inflammatory mass which becomes adherent to the bladder as in diverticulitis. In later stages of the disease tumor tissue may actually invade the bladder wall and lead to fistula formation.

During the past five years at the Massachusetts General Hospital 146 patients with cancer of the large bowel, not including growths of the rectum, have been operated upon. That the sigmoid was the site of the tumor more frequently than any other portion of the colon is evident from these figures:

Situation	*Cases*
Cecum	15
Ascending Colon	13
Hepatic Flexure	5
Traverse Colon	22
Splenic Flexure	10
Descending Colon	4
Sigmoid	77
	146

When the growth originated in the sigmoid there were definite adhesions to the bladder in ten instances (13 per cent). In but one instance of cancer of other parts of the bowel was the bladder involved and this was in an extensive malignant tumor of the cecum. The impression was given, from reading the operative notes of these tumors of the sigmoid, that adhesions to the bladder existed in many more of these patients because the tumor mass was fre-

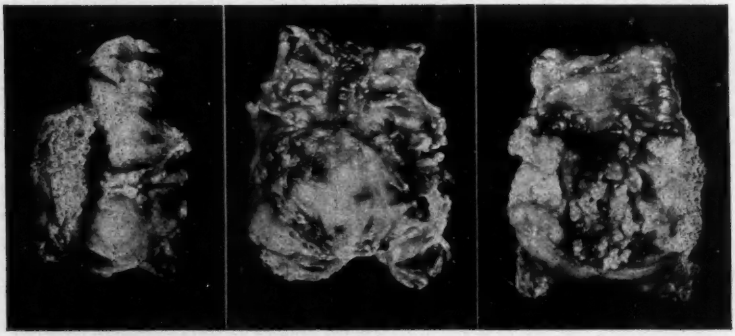

Fig. 1 *(left)*. Carcinoma of sigmoid involving bladder. Length of large bowel removed by resection with portion of bladder through which the tumor has grown.

Fig. 2 *(center)*. Bladder mucous membrane through which the tumor has spread.

Fig. 3 *(right)*. Lumen of the bowel open and containing an annular constricting tumor.

quently described as "adherent." A fistula between the sigmoid and bladder was described in one patient. Growths of the sigmoid, then, are much more likely to involve the bladder than neoplasms which arise from other parts of the colon. Fifty per cent of the patients who had definite adhesions between the sigmoid and bladder gave symptoms of well marked bladder irritability.

The character of these new growths varies with their situation and so do the symptoms which they produce. Carcinomas of the left colon are apt to be scirrhous in type and cause obstruction by their annular constricting growth, while those of the right colon are more commonly flat and ulcerating with less tendency to encircle the bowel. Because of this, and due to the fact that the fecal content of the left bowel is solid rather than liquid, obstructive

symptoms are more characteristic of cancer of the left colon. Secondary anemia without obstruction is more typical of the right-sided lesions.[4] In any situation, the disease is often insidious with mild constipation the only symptom for many months. During this time the new growth may involve structures other than the bowel and result in the first symptoms which are considered seriously by the patient. Bladder irritability is such a symptom and appears when adhesions form between the bowel and the bladder. Less often actual invasion of the bladder by tumor tissue causes hematuria, and such bleeding may be the first noteworthy symptom. The passage of air or feces in the urine heralds the establishment of a fistula and again may be the first hint of trouble. Certain patients who have disregarded an increasing constipation are sufficiently impressed by the onset of these symptoms to seek advice. Although symptoms such as these are usually evidence of an advanced degree of malignant disease with a grave prognosis, nevertheless, cancer of the sigmoid tends to remain a localized affair for a considerable period and does not quickly metastasize.[3] The mobility of the bowel permits wide surgical excisions with a reasonable expectation of cure. Extension of the cancer to the bladder is serious, but does not necessarily render the condition hopeless. Thus Rankin[5] recently said, in discussing cancer of the colon, "There is a group of cases in which local fixation to adjacent viscera such as the bladder or uterus demands multiple resections, such as complete hysterectomy or partial cystectomy, in addition to resection of the colon. I have operated in a number of such cases without increasing the mortality, but with unsatisfactory ultimate results. I believe, however, that such cases may be selected with justification under certain circumstances and that it is distinctly worthwhile to give these individuals a period of comfortable existence and let them return to their work, if it may be done without too much operative risk. Such procedures should always be considered as palliative and as involving a high operative risk."

Although general surgical opinion varies in the management of cancer of the colon, there is agreement on certain points. It is generally accepted that a preliminary drainage operation, colostomy or cecostomy, is advisable if any degree of obstruction is present.[1,2] Carcinoma of the right colon is usually treated by ileocolostomy and resection of the diseased bowel. In the transverse colon

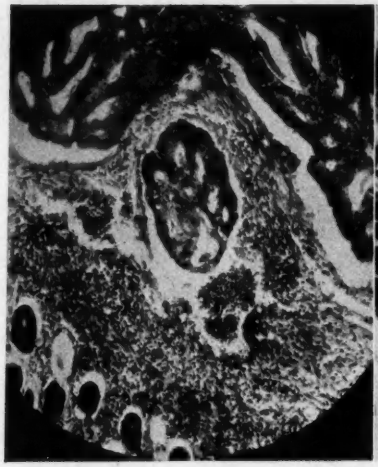

Fig. 4. Photomicrograph of a section of the bowel showing cancer tissue and inflammatory reaction.

Fig. 5. High power photomicrograph of the tumor.

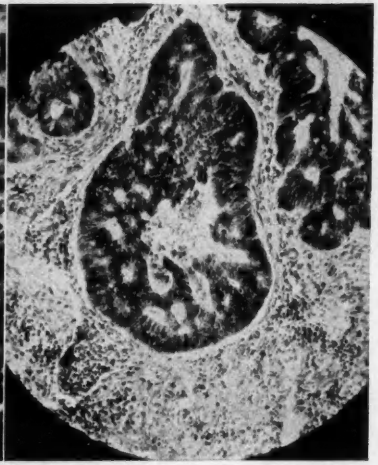

Fig. 6. Section of the bladder wall showing the invading adenocarcinoma from the bowel.

primary resection and anastomosis, with or without cecostomy or colostomy, or a Mikulicz procedure, is commonly performed. When the growth involves the left colon, from the splenic flexure to the lower third of the sigmoid, the choice of operation is more difficult. Rankin favors a modified Mikulicz operation with preliminary decompression of the bowel by cecostomy and considers the dangers of primary resection and anastomosis too high to use as a routine. Cheever believes that in this situation a permanent type colostomy should be made first in the tranverse colon, with subsequent resection of the lesion and end-to-end anastomosis. The Mikulicz type of resection has been frequently employed when dealing with cancer of the sigmoid. This procedure is limited, however, to cases where the growth is movable and the mesentery sufficiently long to permit easy withdrawal of the mass outside the abdominal cavity without danger of bowel necrosis from undue tension on the blood supply. If marked infection has caused thickening of the bowel and shortening of the mesentery, or if obstruction is present, the bowel must be drained by a preliminary operation. Obese individuals with a short mesentery do not lend themselves to this procedure.

The choice of operation as applied to the problem likely to be encountered by the genito-urinary surgeon does not have so wide a range. The sigmoid is the portion of the colon most commonly diseased as a source of malignant extension to the bladder, and is the most mobile part of the bowel. Resection of the diseased bladder wall and its closure subjects the patient to a considerable amount of operating and the simplest, easiest, and quickest method of removal of the diseased bowel is, undoubtedly, the best.

A modified Mikulicz procedure or obstructive resection appears best suited to such a situation, provided the colon can be readily mobilized and the loops of bowel can be drawn out of the wound to a sufficient degree to permit wide resection. When this is not possible a simple resection and permanent colostomy is probably the best procedure.

While it is true that most cases of this nature are handled by the general surgeon, in an occasional instance the problem is forced upon the genito-urinary surgeon, especially if the symptoms are such that attention is directed chiefly to the urinary tract and the

true condition is not appreciated. Such were the circumstances with the following patient:

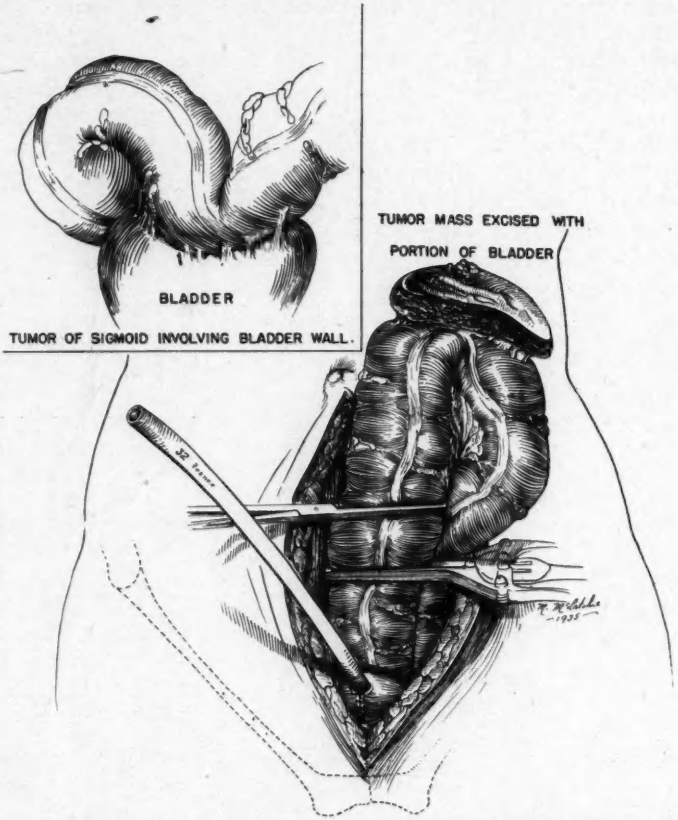

Fig. 7. The fundus of the bladder has been removed along with the invading tumor of the sigmoid. The excised tumor mass with a portion of the bladder is shown adherent to the large bowel, with clamps applied preparatory to removal after the Mikulicz procedure. The bladder has been closed around a mushroom catheter.

In November, 1934, a janitor, fifty-one years old, was admitted to the Massachusetts General Hospital from the diagnostic clinic of another institution, with a diagnosis of papillary carcinoma of the bladder. Previously well, except for a hemorrhoid operation many

years before, he began to feel poorly one year ago. Increasing constipation necessitated the frequent use of saline cathartics. At the same time he noticed that the bowel movements were black and accompanied by small clots of fresh blood. Soon urination became frequent and painful. Four months after the onset of these symptoms the urine was red for three days, and pink at intervals of every few weeks. During the past two months the frequency, dysuria and constipation became increasingly worse and were associated with a con-

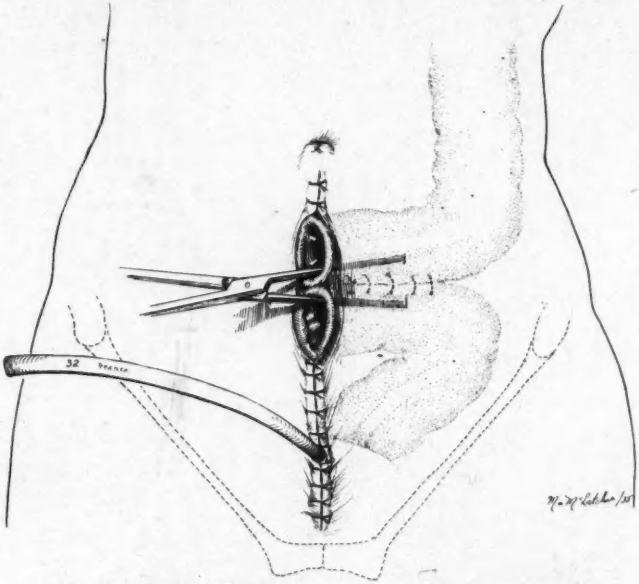

Fig. 8. Cutting through the septum of the large bowel to reëstablish its continuity, a later stage of the Mikulicz resection for cancer.

stant dull ache in the left lower abdomen. He had lost 10 pounds in weight during the year.

The noteworthy features of the physical examination were a rather slight individual in moderately good condition with a somewhat tender, firm, freely movable mass in the left lower quadrant of the abdomen. This mass was about 6 cm. in diameter and could be felt on rectal examination, through a normal bowel wall. A barium enema demonstrated a 4-inch obstructive lesion situated in the sigmoid and typical of cancer. Blood and pus were present in the urine. There was slight secondary anemia with a count of 4,000,000 red corpuscles and

a hemoglobin of 80. The leukocyte count was 8,900, the non-protein nitrogen 37, and the blood Wassermann was negative. Examination

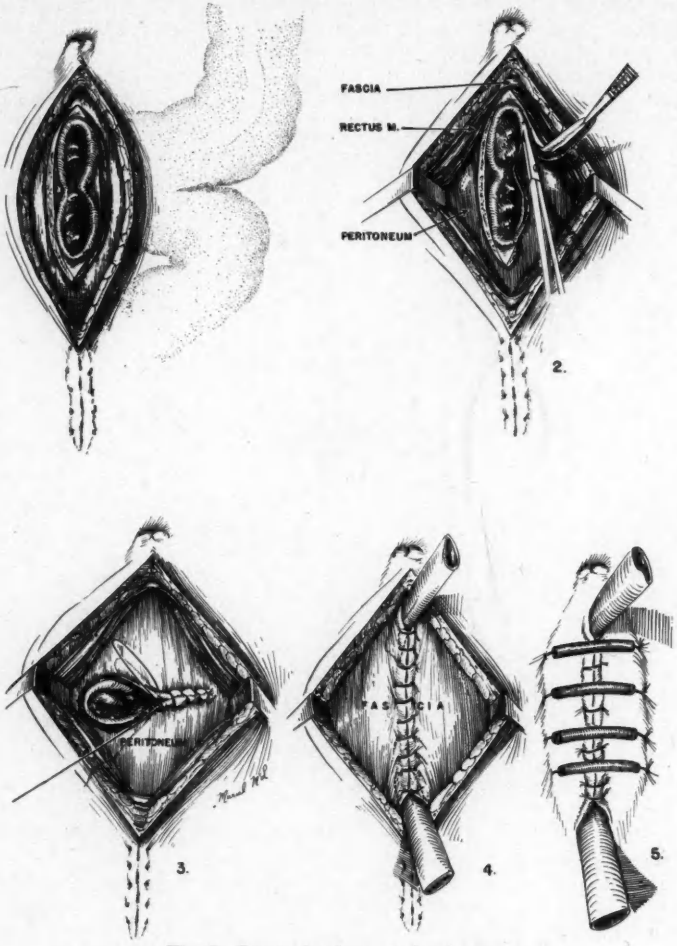

Fig. 9. Stages in closure of colostomy.

of the bladder by cystoscopy revealed a red papillary growth 3 cm. in diameter which involved the left side of the base and was well above the trigone. The tumor was accompanied by considerable in-

fection and had the appearance of the usual sloughing papillary carcinoma arising from the bladder mucosa. The kidneys and ureters appeared normal by intravenous pyelograms, but the bladder was grossly deformed in the cystogram by a large filling defect of the left side.

Because of the typical appearance of the bladder neoplasm and the free mobility of the bowel tumor it was thought that two independent new growths were present, one arising from the bladder and the other from the bowel.

At operation on November 26, 1934, with exposure of the bladder it became evident at once that the vesical tumor represented an invasion from a neoplasm of the large bowel. Upon opening the peritoneum there was found a large hard tumor of the sigmoid firmly adherent to the bladder. However, a radical removal of the whole tumor mass seemed possible. The entire fundus of the bladder was excised, removing the involved portion of the bladder wall with a margin. The bladder was closed around a mushroom catheter. This left a disk of bladder wall adhering to the bowel and it was now found that the whole tumor mass with the involved sigmoid could be easily drawn out of the peritoneal cavity. The sigmoid could then be resected without difficulty by a modified Mikulicz technic, leaving a wide margin of uninvolved bowel on each end. These steps are shown in the accompanying illustrations. At the end of the operation the patient was given a transfusion of 600 c.c. of whole blood.

Pathologic examination of the tissues removed showed a section of sigmoid 17 cm. in length with a completely annular fungating tumor 7 cm. in diameter in its central portion. The mass included a circular area of bladder wall attached to the bowel by tumor extension. Cancer tissue extended through the bladder mucosa. Several lymph nodes in the mesentery of the removed bowel contained no tumor cells. Pathologic diagnosis: Adenocarcinoma of sigmoid, Grade II, with extension to bladder.

The patient stood operation well and had little abdominal distention. The clamp on the bowel was removed on the fourth day. Convalescence was long, but not marked by any untoward incident. Fifteen days after operation the septum between the two loops of bowel was cut through by a clamp as shown in the illustrations. The suprapubic tube was removed and the bladder closed with urethral drainage in about nine weeks, despite considerable fecal contamination from the open bowel. The colostomy functioned well, bowel movements being occasionally passed by rectum. The patient was discharged on February 6 with a bladder of small capacity, but a clear urine and an open colostomy. Three weeks later he returned to the hospital for closure of the colostomy. His general condition was excellent, he had gained 10 pounds, had a clear urine and voided 10 or 12 ounces at a time. On March 2, the colostomy was closed under local anesthesia. The wound healed without infection and the patient

was discharged in two weeks with the bowels moving normally by rectum. Recent examination found the abdominal wound solidly healed, with no fistula or hernia, and both bladder and bowel functioned normally. The patient had gained over 30 pounds in weight.

The case is an instance of extensive invading cancer of the bowel, not frequently encountered, but for which radical operation has given relief with a possibility of cure.

SUMMARY

Cancer of the sigmoid involves the urinary bladder by adhesions or tumor extension in about 13 per cent of the cases. Since these new growths are usually not highly malignant and do not tend to metastasize early their radical removal is indicated whenever possible, even if there is considerable involvement of the bladder.

REFERENCES

1. CHEEVER, D.: The choice of operation in carcinoma of the colon. Trans. Am. Surg. Assn., 59:291-302, 1931.
2. DUDLEY, G. S.: Mikulicz type of colonic resection. Surg. Clin. No. Am., 13:311-314, (April) 1933.
3. GOETSCH, E., and GOETSCH, A.: The diagnosis and surgical treatment of carcinoma of the colon. Arch. Surg., 18:998-1035, 1929.
4. LAHEY, F. H.: Carcinoma of the colon. Am. Jour. Surg., 21:64-73, 1933.
5. RANKIN, F. W.: Cancer of the colon. Surg., Gynec. and Obstet., 59:410-414, 1934.
6. TELLING, W. H. MAXWELL, and GRUNER, O. C.: Acquired diverticula, diverticulitis and peridiverticulitis of the large intestine. Brit. Jour. Surg., 4:468-531, 1916-1917.

CYST OF THE BLADDER

REPORT OF A CASE

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Cyst of the bladder, except the small blebs of cystitis cystica, is a very rare condition. In a review of the literature I have found only four case reports, although some authors state that these cysts are equally common in men and women.

Watson and Cunningham credit Albarran with the following: Simple cysts have been described by Rokitansky and Klebs, the latter calling them herpes of the bladder. Lenibeck gave a detailed account of them in 1887. Vincent and Laboulbene have reported cases of very large cysts of this nature. Ordinarily they are small and have been likened in appearance to the fresh egg of the sturgeon, and are scattered over the inner surface of the bladder, sometimes in large numbers. They have a content of viscid fluid, and in one case Lenibeck found crystals of carbonate of lime. A very large cyst of somewhat similar character was seen by Segond and Thier. Celen reported it in 1891. It protruded from the vulva, arose from the muscular layer of the bladder and had a connective tissue wall and a serous content. The inner lining of the cysts, as they usually appear, seems to be provided with an epithelial covering of its own, while its outer surface is supplied with another layer of epithelium, the latter being that of the vesical surface itself. A section made through the whole bladder wall and passing through the cyst, therefore presents on inspection these two layers of epithelial cells, one on either side of a delicate partition of connective tissue which represents the cyst wall. My case was of this type.

Albarran believes these cysts originate in the glands of the bladder mucous membrane.

Kelly and Burnam say: Cysts of the vesical mucosa are not infrequently associated with a cystitis. A number of authors have reported a cystic degeneration of the base of the bladder, sometimes associated with cysts in the ureter. In size they vary from a few millimeters to a centimeter in diameter, occasionally they are large and pedunculated.

Brongersma[1] cites two cases, a woman of fifty-two and a man of thirty-two, with a study of the literature. The tumor in the woman was about the size of a walnut with a base 1 cm. in diameter. It was situated near a normal left ureteral orifice, the contents were clear and the consistency that of glycerine. The patient complained of pain in urinating and of a stoppage. The walls of the cyst were made up of vesical mucosa, a slightly edematous submucosa with dilated vessels, here and there groups of leukocytes and a normal muscular layer followed by a layer of connective tissue with a lining of epithelium.

In Young's Urology, epithelial adenoma is spoken of as solid or cystic. Small complicated glands resembling those of the posterior urethra occur rather commonly at the vesical orifice, in the mucosa over the trigone and more rarely elsewhere in the bladder. Young cites no true cysts, but shows a microphotograph of a cystic adenoma.

Keyes says: Several varieties of cysts occur in cystitis, they have no clinical significance.

White and Martin, Thomas and Moorehead say: Epithelial cysts are equally common in men and women, and are observed during any period of life except in early infancy, and are most frequent between the thirtieth and fiftieth years. They are usually placed about the base of the bladder in the region of the vesical neck, probably because the vesical glands are particularly abundant in these regions. They may occupy the entire vesical cavity and are sometimes associated with cysts of the kidney pelvis. Clinically they are distinguished according to size as large or small.

Park, in Modern Surgery, quoting from Clado on Tumors of the Bladder, says: Large epithelial cysts show a tendency to become enucleated from the vesical wall and form pedunculated growths.

Vincent records a case in a child three to three and a half years old, in whom the pedicle was so long the cyst passed through the urethra and appeared in the vulva.

Eisendrath and Rolnik say: Glands are not found in the normal bladder mucosa. Under the influence of infection the surface epithelium sends down outgrowths, which may be solid buds or glandlike depressions (Brunn) ending in cyst formation. The first

results of such changes are the appearance of minute vesicles usually with clear contents and called cystitis cystica.

McFarland's Surgical Pathology, under the heading, Retro-Vesical Cysts, says: Small cysts rarely observed upon the posterior wall of the bladder not far from its neck, have a different origin and presumably originate from vestiges to Muller's tubes. They are very rare, usually very small, and have no surgical significance.

CASE REPORT

C. R., male, white, aged four years, was seen first February 1, 1934.

He had difficulty in starting the flow of urine, frequency, voiding only a small amount each time, tenesmus and dysuria.

The symptoms began eighteen months before I saw him and have gradually increased in severity. For the past week he had had suprapubic pain, chilly sensations and fever.

Father, mother, two sisters and one brother were reported living and well.

Physical examination revealed a fairly well nourished boy, crying and restless from frequency, dysuria and suprapubic pain. Heart and lungs were normal. Abdomen was normal except for tenderness just above the symphysis pubis. Kidneys were not palpable, but there was tenderness over both loins. The boy was dehydrated. His temperature was 100.6, and pulse 128. Red cell count was 4,010,000, hemoglobin 78, creatinin 1.75 and non-protein nitrogen 30 mg. per 100 c.c. of blood.

Urinalysis findings were: 1.015 specific gravity, alkaline, dark reddish color, 3 plus albumin, no sugar, no casts, many red blood cells and innumerable pus cells.

Cystoscopy revealed a condition of chronic cystitis. The bladder was dilated and the mucosa appeared thin, like many of the dilated bladders in cases of hypertrophy of the prostate. Good vision could not be obtained, as a mass, either a tumor or an infolding of the bladder wall, so obstructed the view that diagnosis other than tumor of the bladder, which I thought was a polyp, could not be made. The ureteral orifices were small and would not admit a No. 4 catheter or bougie. An intravenous pyelogram was made and reported as follows: No stone shadows, marked dilatation of the right kidney pelvis and calices, and rotation of the right kidney, some dilatation of middle and lower calices of the left kidney. Both ureters showed marked dilatation. There was not sufficient medium in the bladder to give a satisfactory cystogram. Rectal examination gave no information of importance.

Realizing that the case was operative and as the father's financial condition was poor, I did not pursue any further investigation, but

decided to explore the bladder under the diagnosis of tumor of the bladder.

The bladder was opened suprapubically and found considerably dilated. A large cyst was found springing from a point 1.5 cm. to the right of the margin of the internal meatus, its pedicle extending to within about 1 cm. of the right ureteral orifice. It seemed continuous with the floor of the bladder and gave the appearance of a diverticulum reversed and protruding into the bladder. A rectal exami-

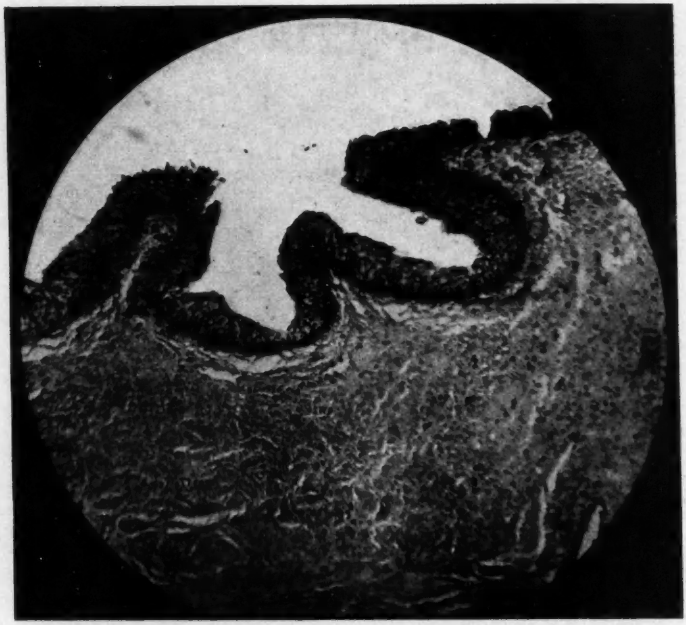

Fig. 1. Microphotograph of outer surface of cyst covered by bladder mucosa and showing rugæ.

nation was made to rule out a diverticulum of the rectum. The mass projected about 2.5 inches into the bladder and appeared to be a cyst covered with bladder mucosa. An attempt was made to enucleate the cyst by splitting the mucosa about its base, but a line of cleavage could not be found. I, therefore, decided to remove it by cutting it near its attachment to the bladder floor. This was done and a clear watery fluid was evacuated, but unfortunately spilled into the bladder and was lost.

As the cyst was cut off and removed, the edges of the pedicle were grasped with forceps. Upon introducing the index finger into the stump, I was surprised to find that the cyst cavity extended below the base of the bladder downward and laterally for at least 1.5 cm. in all directions. I tried to separate the cyst wall but again could find no line of cleavage. I, therefore, decided to attempt to destroy the endothelial lining of the cyst with the high frequency current. A small ball electrode was introduced into the remaining cyst cavity

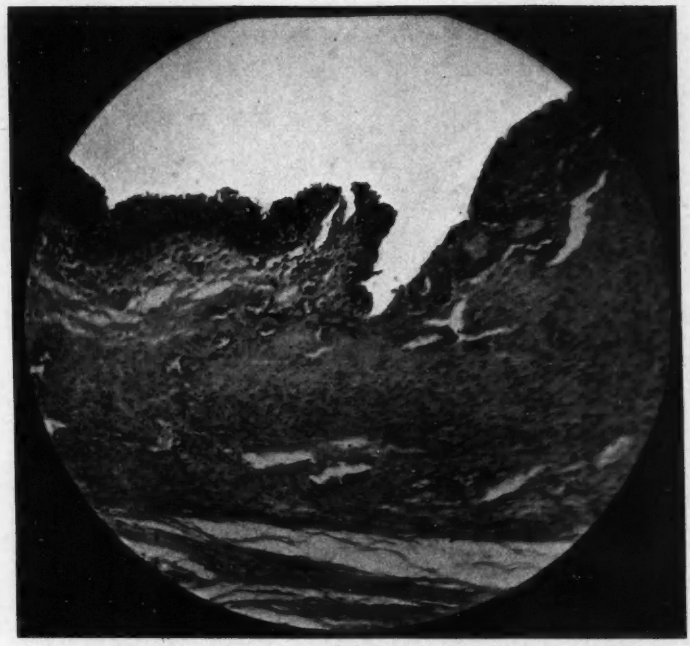

Fig. 2. Microphotograph of epithelial lining of cyst. Similar to that of bladder mucosa.

and its interior thoroughly fulgurated. Realizing the difficulty of entirely destroying all the endothelial cells, I then swabbed the cyst cavity, first with carbolic acid and then with alcohol. A small gauze wick was placed in the cyst cavity, the bladder closed over it, and the wick brought out through the suprapubic wound by the side of a 36 F. suprapubic tube. The drain was removed in forty-eight hours, and the suprapubic tube on the ninth day. The patient left the hos-

pital in two weeks and his suprapubic wound was healed three weeks after operation.

His parents were instructed to bring him back for cystoscopy and pelvic lavage, but on account of finances did not do so until one year after the cyst had been removed, and then only because the boy had fever and a return of his frequency, tenesmus and burning.

Upon cystoscopic examination at this time, March 15, 1935, the bladder showed no evidence of the cyst. In fact, I could find no cicatricial tissue in the region from which it had been removed. An x-ray showed a stone about one-half inch long in the pelvis of the left kidney. Cultures from the left kidney showed colon bacilli and Staphylococci, and, from the right, colon bacilli. Intravenous phenolsulphonephthalein output from the right was 15 per cent; from the left, 5 per cent.

I removed the stone from the left kidney by pyelotomy and the patient made an uneventful recovery. As the stone was an alkaline one he was put on an acid ash diet, viosterol and urotropin. Pelvic lavage has been instituted and ordered continued with the hope of clearing up the infection and relieving the dilatation.

The pathologic report by Dr. N. F. Leake was as follows: A thin walled cyst sac partially bisected when received, measured about 6 centimeters in diameter. The lining presented several elevated irregular areas which were yellowish white. These areas were surrounded by zones of what was apparently ulceration. The sac was about 3 centimeters in thickness.

Microscopic examination showed both sides of the cyst wall covered with transitional epithelium. Prominent rugæ were noted on the bladder mucosa. On the inner surface, the cyst lining presented an area of ulceration characterized by loss of surface epithelium and necrosis of subepithelial structure. The area of necrosis was surrounded by dense leukocytic infiltration consisting chiefly of eosinophiles, polymorphonuclear and round cells. There was no distinct basement membrane between the epithelium and the connective tissue of the lamina propria. The remainder of the cyst wall was composed of loose connective tissue through which longitudinal strands of smooth muscle fibers were discernible. Numerous thin walled capillaries, extravasated blood and some edema were noted.

Theories as to the origin of the cyst in the case herewith reported are as follows:

1. The most plausible origin of the cyst is that it was formed from an infolding or downward growth of bladder epithelium (Brunn) with resulting development of a cyst covered by the mucosa of the bladder that grew upward into the bladder, and also grew downward beneath the base of the bladder.

2. As the trigone is derived from the Wolffian duct and is

therefore of mesodermal origin and the remaining portion of the bladder lining is of entodermal origin, the junction of the two may have resulted in the infolding of the one or the other with resultant cyst formation.

3. The least probable theory is that it was formed from the occlusion of one of Albarran's glands.

BIBLIOGRAPHY

1. BRONGERSMA: Ztschr. f. Urol., 2:459, 1908.
2. EISENDRATH and ROLNIK: J. B. Lippincott & Co., 1928.
3. KELLY and BURNAM: D. Appleton & Co., 1914.
4. KEYES: Urology. D. Appleton & Co., 1928.
5. MCFARLAND: Surgical Pathology. P. Blakiston Sons Co., Philadelphia, 1924.
6. PARK: Modern Surgery. Lea and Febiger, 1907.
7. WATSON and CUNNINGHAM: Lea and Febiger, 1908.
8. WHITE and MARTIN: Thomas and Moorhead. J. B. Lippincott & Co., 1917.
9. YOUNG: Practice of Urology. W. B. Saunders & Co., 1926.

RUPTURE OF THE URINARY BLADDER ASSOCIATED WITH PROSTATIC HYPERTROPHY

CASE REPORT

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Rupture of the urinary bladder occurs rarely; it is usually difficult to recognize and the mortality is still high, even in this period of accurate urologic diagnosis and skillful surgery.

In the early days of surgery many famous physicians were concerned seriously with the study and treatment of rupture of the bladder. Hippocrates[18] in his writings stated that a severe wound of the bladder was deadly. Galen[15] in later years commenting on the aphorisms of Hippocrates states that this term "deadly" meant a very dangerous wound, but not necessarily a fatal one. Besley[4] states that until the end of the 16th century the authority of Hippocrates was so strong that no one would have been bold enough to report a case of recovery. No one expected patients with bladder rupture to recover and usually they did not. Even up to the time of the elder Larrey,[22] the famous surgeon of Napoleon's time, the opinion of Hippocrates was universally accepted. Larrey reports that the old grenadiers of the empire, accustomed to be under fire, not troubled with diuresis or incontinence before a battle as were the new conscripts, and even forgetting to empty their bladders in their ardor to fight, were much more commonly seen with ruptured bladders. Other men such as Velpeau,[38] Von Mikulicz,[27] Dupuytren,[13] and later, in our country, Otis,[32] Keen,[19] and Ashurst[1] all reported cases or offered suggestions for the relief of a condition that usually resulted in certain death. Syme,[37] the famous English surgeon, was the first (1848) to make a successful surgical intervention for the relief of an intraperitoneal rupture.

ETIOLOGY

The factors usually associated in producing rupture of the bladder are distention, a variable type of trauma and not infrequently an associated mental or alcoholic incompetence. Cases of bladder

rupture are divided into two groups depending on whether the rupture occurs intraperitoneally or extraperitoneally.

Berndt,[3] in experiments on cadavers, found that rupture caused by intravesical fluid pressure alone most commonly resulted in extraperitoneal tear. In twenty-four cadavers in which rupture was caused by a blow on a full bladder, the rupture in nineteen was extraperitoneal, in five intraperitoneal. Von Dittel,[12] who carried out a somewhat similar series of experiments, found that when rupture was caused by a simple distention with water, one-half the cases ruptured into the peritoneal cavity, the other half extraperitoneally. If distended by air the rent almost always occurred intraperitoneally.

In a small group of cases, rupture occurs without external violence, usually following distention caused by obstruction to the urinary outflow; in most of these cases there is also an associated disease of the bladder wall. In a number of cases rupture occurred as the result of some interference with the nerve supply of the bladder, namely—a spasmodic or paralytic closure of the bladder outlet. White and Wigram[40] reported a case of extraperitoneal rupture into the abdominal wall in a patient with complete paralysis of the bladder and Herting cites three cases of non-traumatic paralytic rupture. Frieberg[14] reported a case of intraperitoneal rupture from overdistention without injury in a tabetic patient; three and one-half liters of fluid were obtained through a catheter inserted urethrally. Regarding paralytic rupture, Morel[28] states that there are two factors working when rupture occurs as a result of paralysis: toleration of the bladder which permits it to dilate, and degeneration of the bladder muscles so that they offer very little resistance to the distention. In a number of cases rupture occurred directly as a result of some disease of the bladder wall which weakened it. Hedran[17] reported a case in which spontaneous rupture occurred through an area of fatty degeneration of the bladder wall; autopsy showed that this patient also had a luetic aortitis. Castaigne[8] noted a case in which the rupture was through a simple ulcer of the posterior wall. Ludwig[24] described a case of spontaneous perforation through the bladder wall in an area occupied by a papillary tumor. Crosbie[10] reported a spontaneous case through a bladder wall weakened by an infiltrating carcinoma. In a case of Bitschai's[5] in which there was a tumor in the base of the

bladder, a perforation occurred through the upper posterior wall into the peritoneal cavity. There was no bladder muscle at the site of perforation, the area having been replaced by inflammatory connective tissue. Goldenberg[16] reported two cases in which the sudden muscular compression of the abdominal muscles resulting from lifting heavy objects caused intraperitoneal ruptures. Mailland[25] described a case of rupture secondary to pressure necrosis of the bladder wall from a uterine fibroma. Chattaway[9] reported the case of a woman, four months pregnant, who had a spontaneous intraperitoneal bladder rupture following forty-eight hours of urinary retention; one gallon of urine was removed from her abdominal cavity. In some cases rupture, while not caused by external trauma or violence, is, nevertheless, the result of influences outside of the bladder itself and is not in the true sense a spontaneous occurrence. Such may occasionally follow diagnostic and therapeutic procedures on the bladder. Rupture has not infrequently occurred from overdistention during a cystoscopy; general and spinal are not as safe as sacral anesthesia for these cases, because in sacral anesthesia the pain sense from overdistention is not completely lost. Wagner[39] reports six cases of rupture after the injection of fluids into the bladder and Neve[31] noted that rupture occurred following the injection of only 270 c.c. of fluid preparatory to doing a litholapaxy. Cassuto[7] described a case in which rupture of the bladder resulted from an intravesical explosion of the gases accumulated from fulguration of the bladder neck. Saint Cene,[34] who reported two analogous cases, found that the explosion took place on fulgurating near the upper surfaces of the bladder where gas accumulates. Kretschmer[21] recently reported two cases of intravesical explosion with rupture of the bladder during transurethral electroresection of the prostate.

Occasionally a case is described in which rupture seems to be the result of mechanical obstruction alone. King[20] reports a case of bladder rupture occurring in a fetus with an imperforate urethra and Sisk[36] quotes a case of Talboys in which rupture occurred as a result of unrelieved phimosis. Rather exceptionally rupture of the bladder is seen in association with stricture of the urethra or prostatic obstruction. In both these conditions there is usually an associated cystitis and a degeneration of the musculature of the bladder wall. Sisk[36] reported a case of spontaneous extraperi-

toneal rupture of the bladder as a result of obstruction to the urinary outflow by a urethral stricture that had been present since childhood. Similar cases have been reported by Lejars[23] and Besley.[4]

Cases in which rupture of the bladder occurred in association with prostatic hypertrophy are very rare, but allusions to such conditions are occasionally seen in the literature. Rupture in such cases occurs primarily due to obstruction at the bladder neck and secondarily increased intravesical pressure plus degenerative changes in the bladder wall. Moser[29] reports the case of a man aged fifty-nine in whom rupture occurred as a result of long standing dilatation of the bladder caused by hypertrophy of the prostate.

The following case is one in which prostatic obstruction caused a chronic distention of the bladder, cystitis, disease of the bladder wall and finally a rupture into the extraperitoneal tissues.

CASE REPORT

A man, aged seventy-six, had been having difficulty in urination during the last three years. There was frequency, nocturia every hour, and it was usually necessary to strain considerably to empty his bladder even partially. He had had some dribbling for a year, but during the last six months there had been a gradually increasing incontinence; for the last three months he passed no urine except that which dribbled out. During this time he was in bed most of the time and found it necessary to make some effort to force out a little urine every hour or two during the day or night. Seven days ago he had as he expressed it a "gripe in his abdomen" since when he has had constant abdominal pain and tenderness and a mass in the lower abdomen which gradually increased in size, and is now the size of a grape fruit. He has been catheterized only once, shortly before coming to the hospital.

On entry into the hospital his temperature was 96 F., his pulse 84, and his blood pressure 120 systolic, and 70 diastolic; his pupils reacted normally and his other reflexes were not unusual. He was in moderate shock but roused readily when questioned. His lungs were clear and his heart regular, with faint sounds and no murmur. His arteries were tortuous and sclerosed, but compressible. The bladder was markedly distended and on the abdominal wall above the pubes a hard rounded non-fluctuant fixed mass, about 8 cm. in diameter, could be felt. After catheterization of the bladder the mass was slightly less prominent and more freely movable, but apparently did not diminish in size. Thirty ounces of cloudy, foul-smelling urine were removed with the catheter. The catheter was fastened into the urethra and left in place. The prostate was about twice the normal size, firm, fixed and rounded, but not irregular or exceptionally hard.

The urine contained a large amount of pus, blood and albumin, but no sugar. An examination of the blood showed a hemoglobin of 48 per cent; and each millimeter of blood contained 3,200,000 red cells and 21,000 leukocytes, 83 per cent of which were polymorphonuclear cells. Roentgen examination of the kidneys, ureters and bladder revealed nothing unusual except an area of increased density in the region of the suprapubic mass. A Wassermann test on the blood gave negative findings.

Two conditions presented themselves for consideration: a cystic formation of the lower end of the urachus or a ruptured bladder; the latter diagnosis seemed substantiated by the long history of urinary difficulty, the sudden onset of the tumor and the bladder neck obstruction. The patient was in moderate shock and the urinary retention was satisfactorily relieved by the inlying urethral catheter. Consequently only a simple incision and drainage of the mass appeared to be necessary. The patient was taken to the operating room and under a local anesthetic a midline incision was made in the suprapubic mass. Between the muscles and the overlying fascia there was a collection of about 4 ounces of foul, highly-infected urine. The area was drained and the wound closed loosely. The bladder was not exposed and no urine was seen oozing into the wound as the bladder was kept empty by means of the urethral catheter. As the patient was somewhat in shock nothing further was done. He recovered rapidly from the operation and several days later the two-hour intravenously injected phthalein was 15 per cent; 5 per cent the first hour and 10 per cent the second. Five days after this it was 25 per cent for the two-hour period. The wound healed readily and the patient's general condition improved. An electrocardiagram showed indications of myocardial changes and a suggestion of generalized arteriosclerosis.

Cysto-urethroscopy revealed an enlargement of the lateral lobes of the prostate (two on a scale of one to four) together with an enlarged middle lobe. The bladder wall was markedly trabeculated and there were many small cellules. In the anterior upper wall of the bladder there was an area of inflammation about 2 cm. in diameter, in the center of which were several linear tears or scars.

As the patient did not readily tolerate a permanent urethral catheter, it was removed after a few days and suprapubic drainage was instituted under a local anesthetic. The skin and fascia were cut and the muscles retracted. The peritoneum and structures overlying the bladder were matted down, thickened, adherent and friable but were stripped from the surface of the bladder without much difficulty. No evidence was found of an open urachus or of anything resembling the urachus. The area through which the bladder had opened into the overlying tissues could be readily made out, but no fluid was coming through at this time. The bladder wall was very friable and at least 1 cm. thick. It was incised with a knife and a

No. 30 Pezzer tube fixed in place. Exploration of the bladder revealed nothing unusual but the enlarged prostate.

The bladder was closed and the patient made a good operative recovery. He left the hospital two weeks later to go home, the suprapubic tube being still in place; he returned one month later for prostatectomy.

DIAGNOSIS

Patients with traumatic bladder rupture generally have severe pain in the lower abdomen at the time of injury. This pain is continuous, is associated with vesical tenesmus and usually the patient is in moderate shock. The symptoms in cases of spontaneous rupture differ very little from those when rupture is caused by trauma. Spontaneous rupture is more likely to occur in elderly individuals with a history of prolonged bladder trouble. Generally in cases of rupture there is a strong desire but inability to urinate, or only a few drops of blood may pass. In some cases voiding may be quite free, the urine being blood-tinged. Besley noted that the patient is usually unable to walk or walks with difficulty and that at the time of injury there is a sense of something giving way or tearing in the lower abdomen.

If the rupture is extraperitoneal there is usually pain and swelling in the suprapubic area and there may be signs of extravasation such as brawny edema or pitting of the tissues. The patient becomes septic and at times has chills and fever. Intraperitoneal ruptures, which, unfortunately, are the more common type, are more serious and at times quite difficult to recognize. Symptoms of peritonitis appear early, such as abdominal tenderness, muscular rigidity and later vomiting and obstipation. On the other hand a number of cases of intraperitoneal rupture have been reported in which the abdominal cavity was filled with urine for several days without signs of peritonitis.

The two most common means of diagnosis are the catheter test and the injection test. The patient may be catheterized and no urine or only a small amount of bloody urine obtained, or possibly an amount is withdrawn much greater than could be contained in a normal sized bladder. No urine or a large amount of urine from an individual who has not voided for a considerable time is added evidence of bladder rupture. The bladder opening may have permitted the urine to escape into the peritoneal cavity from where it cannot be withdrawn or there may be such a large tear in the

bladder wall that a free flow back and forth is possible. In some cases extremely large amounts may be withdrawn; Freiberg drained off over 3 liters by catheter. In the injection test a measured amount of solution is injected into the bladder and then withdrawn, a smaller or larger return suggesting either a loss or a gain in fluid through an opening in the wall.

Cystoscopy in some cases may be of little value on account of inability to distend and fill the bladder with fluid; however, this difficulty is not so great when using a close vision lens or a direct cystoscope of the Braasch type.

Cystography, following the simple injection of a medium opaque to x-rays, will usually give definite and accurate information as to the condition present. Roentgenography, following the injection of air after removal of most of the opaque medium from the bladder, gives a good contrast picture, usually indicating the condition of the bladder, the location, and, at times, the extent of the lesion present. Mark,[26] observing the innocuousness of media for intravenous urography, has used this medium in a case of extraperitoneal rupture of the bladder, being able, not only to diagnose the condition correctly, but to note accurately the location of the lesion. This procedure has been used recently in an increasing number of cases and generally gives important diagnostic data.

TREATMENT

The treatment in both the intraperitoneal and the extraperitoneal types of rupture is usually immediate operation. This condition is a surgical emergency and delay, particularly when rupture into the peritoneal cavity has occurred, is as dangerous as in the case of any other acute abdominal lesion. When the tear has been through the peritoneum, the abdomen is opened, the bulk of the fluid withdrawn by suction and the rent in the bladder closed. Both the peritoneal cavity and the bladder are then adequately drained. In some cases as shown by Crosbie,[10] if the bladder tear is small it need not be sutured as it will close itself when proper drainage of the bladder is provided. In the extraperitoneal type of rupture, the main procedure is bladder drainage together with drainage of any perivesical pockets or areas of extravasation. Usually individuals with bladder rupture are in poor general condition and

a rapid, accurate, operation is necessary, only what is absolutely essential being done at that time.

MORTALITY

The mortality, even of uncomplicated rupture of the bladder, always has been and still is very high. Complications, and coincidental injuries in the traumatic cases greatly increase the severity of the condition.

Bartels,[2] in 1878, reported a mortality of 96 per cent in ninety-eight patients treated without operation. Rivington,[33] in 1884, collected 300 cases. Thirty-eight patients recovered, of which number thirty were in the smaller group of extraperitoneal ruptures. Although the other eight were described as being intraperitoneal cases, Rivington questions the diagnosis, believing them also to be extraperitoneal in type. This illustrates the viewpoint of that time toward the extreme rarity of recovery in cases of intraperitoneal rupture. Seldowitsch,[35] in 1904, reviewed thirty-four cases from the Russian literature. Twenty-eight (87.5 per cent) ended fatally. Fifteen patients on whom operation was not performed also died. In the same year, Dambrin and Papin,[11] in France, collected and analyzed seventy-eight cases in which operation was done for intraperitoneal rupture, thirty-four (43.5 per cent) of the patients died. Thirty-four patients of this series had been operated on since 1895; of these only seven (23 per cent) died. Negley,[30] in 1927, reviewed thirty-four cases from the Los Angeles General Hospital. Fourteen cases were of extraperitoneal rupture; four patients died, a mortality of 28.6 per cent. There were twenty cases of intraperitoneal rupture; four patients died, a mortality of 20 per cent. In 1929 Campbell[6] reported fifty-five cases from Bellevue Hospital; thirty-five (63.6 per cent) patients died. Of the patients suffering from intraperitoneal involvement twenty-six (73.5 per cent) died; only nine (42.9 per cent) of those with extraperitoneal involvement died.

Besley[4] stated in 1907, "No one condition seems better to illustrate the advances that have been made in modern surgical work than the results now obtained in the treatment of rupture of the bladder." In the early days of surgery almost all patients died, the abdomen was not opened without fear of peritonitis and consequently many patients were not operated upon. The associated

lesions and complications took their toll and, all in all, rupture of the bladder was a very serious condition. Since Besley made his statement, progress in surgery has been much better illustrated by operative results on organs other than the bladder. The present mortality, while still very high, is mainly due to the tremendous shock and the coincidental lesions, conditions putting the patient beyond help when first seen. In only a small part is the high mortality now due to delayed or unskilled procedures. In uncomplicated cases, when operation is early, the prognosis, both for intraperitoneal and extraperitoneal bladder ruptures, should be fairly good.

BIBLIOGRAPHY

1. Ashhurst, A.: Traumatic intraperitoneal rupture of the bladder; with a report of two cases and an analysis of 110 cases treated by laparotomy. Am. Jour. Med. Sci., 132:17-37, 1906.
2. Bartels, M.: Die Traumen der Harnblase. Archiv. f. Klin. Chir., 22:519, 628 and 715, 1878.
3. Berndt, F.: Experimentelle Untersuchungen über Harnblasenruptur: Archiv. f. Chir., 58:815-839, 1899.
4. Besley, F. A.: Rupture of the urinary bladder. Surg., Gynec. and Obstet., 4:514-532, 1907.
5. Bitschai, J.: Spontanruptur der Blase. Ztschr. f. Urol., 21:461, 1927.
6. Campbell, M. F.: Rupture of the bladder: A clinical study of fifty-five cases. Surg., Gynec. and Obstet., 49:540, (Oct.) 1929.
7. Cassuto, A.: Explosion dans la vessie au cours d'une électro-coagulation. Jour. d'Urol. Med. et Chir., 22:263, 1926.
8. Castaigne, J.: Ulcère simple de la vessie: hematuries très abondantes et perforation vesicale. Bull. et Mém. de la Soc. anat., pp. 230-239, 1899.
9. Chattaway, D.: A case of intraperitoneal rupture of the bladder due to retroversion of the gravid uterus. Lancet, London, 2:754, 1921.
10. Crosbie, A. H.: Rupture of urinary bladder. Jour. Urol., 12:431-437, 1924.
11. Dambrin, C., et Papin, E.: Des ruptures intraperitoneales de la vessie sans fractures du bassin, dans les contusions abdominales. Ann. d. mal. des org. gen. urin., 22:641, 678, 721, 745, 801, and 822, 1904.
12. Dittel, von: Gegen die Füllung der Blase zum hohen Blasenschnitte. Wien. Med. Wschr., 36:1505-1539, 1886.
13. Dupuytren: Cited by Dambrin and Papin.
14. Frieberg, T.: Ein Fall von spontaner Blasenruptur und Veränderungen der elastischen Substanz. Virchow Archiv., 202:268-272, 1910.
15. Galen: Cited by Dambrin and Papin.
16. Goldenberg, T.: Beitrag zur Pathologie des Harnblasenrupturen. Beitrag. z. klin. Chir., 61:350-271, 1909.
17. Hedran, G.: Lipomatosis der Harnblase mit nicht traumatischer Ruptur derselben. Arch. f. klin. Chir., 82:1018-1022, 1907.
18. Hippocrates: The Genuine Works of Hippocrates. F. Adams., Wm. Wood & Co.: 1-366.
19. Keen: A new means of ascertaining whether the bladder is ruptured. Ann. Surg., 12:36, 1890.
20. King: Cited by Besley.
21. Kretschmer, H. L.: Intravesical explosions as a complication of transurethral prostatic resection. Jour. A. M. A., 103:1144-45, (Oct.) 1934.

22. LARREY: Cited by Dambrin and Papin.
23. LEJAR: Cited by Dambrin and Papin.
24. LUDWIG: Cited by Besley.
25. MAILLAND: Rupture brusque de vessie, consec. a la compression exercée par un fibrom uterine. Gaz. des hop., 74:1109-1110, 1901.
26. MARK, E. G.: Intravenous urography in the diagnosis of rupture of the bladder. Jour. A. M. A., 100:42, (Jan. 7) 1933.
27. MIKULICZ, VON: Cited by Besley.
28. MOREL, L.: Contribution a l'étude des ruptures traumatiques de la vessie. Ann. d. mal des org. gen. urin., 24:801-810, 1906.
29. MOSER, E.: Spontane Harnblasen zerreissung. Deutsch. Zeit. f. Chir., 132: 103-123, 1914.
30. NEGLEY, J. C.: Rupture of the bladder. Jour. Urol., 18:307, 1927.
31. NEVE, E.: Vesical calculus and rupture of bladder. Brit. Med. Jour., 2:1543, 1899.
32. OTIS: Cited by Besley.
33. RIVINGTON, W.: Rupture of the urinary bladder. Med. Press and Circular, 34:434, 455, 477, 499 and 526, 1882; 35:1, 27, 48 and 69, 1883.
34. SAINT CÉNE: Cited by Cassuto.
35. SELDOWITSCH: Ueber intraperitoneale Rupturen der Harnblase. Arch. f. klin. Chir., 22:859 and 897, 1904.
36. SISK, I. R., and WEAR, J. B.: Spontaneous rupture of the urinary bladder. Jour. Urol., 21:517, 1929.
37. SYME: Cited by Dambrin and Papin.
38. VELPEAU: Cited by Dambrin and Papin.
39. WAGNER, R.: Ueber nicht traumatische Perforation der Blase und ihre Folge zustande. Arch. fur. klin. Chir., 44:303-368, 1892.
40. WHITE, M., and WIGRAM, N. J.: A case of spontaneous rupture of the urinary bladder. Brit. Jour. Surg., 4:324-325, 1916.

DISCUSSION

DR. BENJAMIN S. BARRINGER (New York): I want to speak particularly about Dr. Scholl's paper. I was very much interested in it and particularly in his observation that anesthesia possibly helped to rupture the bladder. I had experience with one case in which the bladder was ruptured by the cystoscope. I didn't see the patient personally, but I was able to go into the history very carefully and my impression in that case was that it was lack of anesthesia that caused the rupture; in other words, the patient was a fractious sort of a gentleman and at one time, just as the cystoscopy was finished, he partially rose up from the table and I believe that was exactly the time the cystoscope went through the bladder. I went over the case very carefully. It wasn't altogether the fault of the operator. It therefore bespeaks the use of anesthesia in difficult cases. I certainly use anesthesia in a difficult case if I think the patient is going to be fractious.

I was under the impression that Dr. Kretschmer's cases were transurethral prostatectomies, in which he introduced a lithotrite evacuator after the resection to wash out the pieces that he had not been able to pull out as he resected them, and that this washing out was the cause of the rupture. It is my impression that the violent washings of the bladder caused the rupture of the bladder in these cases. I may be wrong.

With regard to the retention of urine when entering battle. I think when combatants enter war or players a football game they don't suffer from retention of urine—quite the opposite.

DR. LEON HERMAN (Philadelphia, Pa.): In connection with Dr. Livermore's report the Association might be interested in a case of true dermoid cyst of the bladder wall, which occurred in the service of Dr. R. M. Shepler, of Carlisle, Pennsylvania. The patient was a woman aged fifty. The question arose whether this was a dermoid cyst of the ovary which perforated into the bladder or whether it was a true dermoid cyst of the bladder wall itself, but I believe it to be a true dermoid cyst of the bladder wall.

The patient had symptoms of calculous disease of the bladder and the x-ray showed a saucer-shaped stone and in addition to this

an indefinite shadow apparently lying in apposition with the stone. Unfortunately the plate was taken with the bladder empty. Dr. Shepler exposed the bladder and removed the stone. After he had removed it he explored the bladder with his finger and in searching for the cause of the other shadows encountered a cyst which was perfectly round and sessile. It was possibly as big as a walnut and soft at its apex. The finger went into the cyst, evacuating a lot of pultaceous material, long curly hair, a piece of jaw bone with three teeth, and three additional teeth lying loose in the cavity. Transvesical resection of the cyst wall was done, the bladder wall alone being involved. Dr. Shepler said that the bladder was freely movable, and that there was no reason to believe that the intraperitoneal organs were adherent.

I believe that this case could well be put on record as an authentic case of true dermoid cyst of the bladder wall. If it is a true dermoid cyst, it is, of course, a great curiosity.

In reference to Dr. Scholl's paper, I should like to say that we have had three cases of spontaneous rupture of urinary organs into the peritoneal cavity. None of them was diagnosed until autopsy. Two of them were due to spontaneous rupture of pyonephroses and one was due to spontaneous rupture of a large diverticulum in an old prostatic patient.

Dr. Edward L. Keyes (New York): Not having had any case like that reported by Dr. Colby, but having struggled with various bladder fistulas from malignant and non-malignant lesions of the colon, I should like to compliment him on the splendid result he got. Our results were all bad.

I should like to ask Dr. Scholl whether tuberculosis ever ruptured the bladder. There seemed to be no such record on his chart.

(Slide) Then I should like to show a cystogram which illustrates a method of diagnosing extraperitoneal rupture of the bladder. The patient had a fracture of the pelvis. You will note that the intestines are all out of the pelvis. The pelvis you see is full of urine, and that is a diagnostic feature (after a certain number of hours have gone by).

Dr. James Pedersen (New York City): When doing a litholapaxy it is important not to distend the bladder fully when starting to use the evacuating tube and pump. It is self-evident that

the extra overdistention occurring suddenly when the evacuating pump or bulb is compressed could rupture an already distended, undoubtedly diseased bladder. When evacuating the fragments it is sufficient if the bladder be only full enough to keep the wall from being drawn against the opening in the tube.

Damage to the bladder wall by the lithotrite will not occur if the stone or its fragments be grasped without force and if the lithotrite be turned with the jaws pointing upward, away from the floor of the bladder, before the crushing is started; it being understood that the bladder is in moderate distention throughout the operation.

Some years ago, during my service at Bellevue Hospital, I saw an example of Dr. Scholl's alcoholic group. The man had been celebrating too well and had fallen backward out of a window several feet from the ground. His bladder being overdistended, it promptly ruptured, intraperitoneally. I sutured the bladder and drained the peritoneum. No infection occurred.

DR. T. M. DAVIS (Greenville, S. C.): I have previously reported one case of ruptured diverticulum in doing a resection. As the result of that I constructed a little apparatus that I employ when resecting cases with diverticulum. It may also be used during litholapaxy. It is constructed of a U glass tube, one end of which is connected to the resectoscope inlet or outlet; in the other end is a sliding cork, through which pass two wires. Within the U tube is mercury with a small amount of coal oil on top of the mercury to prevent current arcing. The tube is placed upon a suitable upright and adjusted so that when the mercury contacts the two wires in the cork the pressure will indicate 20 mm. mercury. During operations the mercury will rise in the tube and when the 20 mm. pressure is reached the mercury contacts the wires which are connected with a battery and buzzer, thus shorting across the wires, causing the buzzer to sound and indicating the pressure. The operator will allow the water to escape, preventing excess pressure and danger of bladder injury.

DR. A. J. SCHOLL: In answer to Dr. Barringer's question about the empty bladder of a football player before a game, that is a point I brought out; the old soldiers were used to going into battle, in fact, they took extra drinks of wine and their bladders were usually distended, while the younger conscripts had frequency and

incontinence before their first battles. Consequently rupture of the bladder occurred more frequently in the younger men as compared to the older men.

I don't know what Dr. Kretschmer's procedure in resection is, but in one case that I have followed in which rupture occurred after electroresection the operator was in the habit of removing four or five different sections before removing the working element from the sheath. The bladder was usually distended and a large amount of gas generated before the fluid and gas were allowed to escape. Explosion or rupture of the bladder was due to overdistention, more so than, as Dr. Barringer suggested, as a result of washing out afterwards with an evacuator.

THE RÔLE OF CONGENITAL ANOMALIES IN THE PRODUCTION OF UROLOGIC CONDITIONS IN CHILDREN, WITH SPECIAL MENTION OF CONGENITAL IDIOPATHIC DILATATION OF THE URETER

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Urologic conditions in children are becoming more common in the practice of most urologists. The simplicity of the technic of excretion urography makes this examination available to infants and children of all ages. Many more urologic examinations are being made than heretofore, and these have revealed an increasing number of urologic conditions in infants and children, many having congenital anomalies as predisposing factors.

EMBRYOLOGY

A study of the embryology of the genito-urinary tract reveals that many errors of development may easily occur. At the fourth week of the growth of the embryo, the Wolffian duct joins the cloaca. Later the renal buds protrude from the Wolffian ducts, their stalks becoming the ureters, which eventually separate from the Wolffian ducts and empty normally into the primitive bladder. The Wolffian duct later empties (as the vas deferens) into the primitive urethra or urogenital sinus. More than one bud may start from each Wolffian duct so that two or more ureters or kidneys, or both, may occur on each side. Double ureters may join and have but one opening into the bladder. If two develop, one may end in the bladder in a normal manner, and the second into the urethra or at some place in the external genitalia. In addition to anomalies of number and insertion, anomalies of caliber may occur.

INCIDENCE OF CONGENITAL ANOMALIES

The literature containing clinical reports of urologic conditions in children rarely emphasizes the relationship to congenital anomalies. Large series of autopsy specimens removed from infants and children have been examined and reported. Bugbee and Wolstein

find that 2.3 per cent have genito-urinary tract anomalies. Meredith Campbell reports 7 per cent. John A. Bigler found 13 per cent in the urinary tract alone. One-third of the clinical cases reported by Beer and Hyman had genito-urinary anomalies. Lowsley and Butterfield found twenty-nine among one hundred cases of urologic conditions in children. Helmholz reports ninety-four genito-urinary anomalies during six years of his practice, which he considers

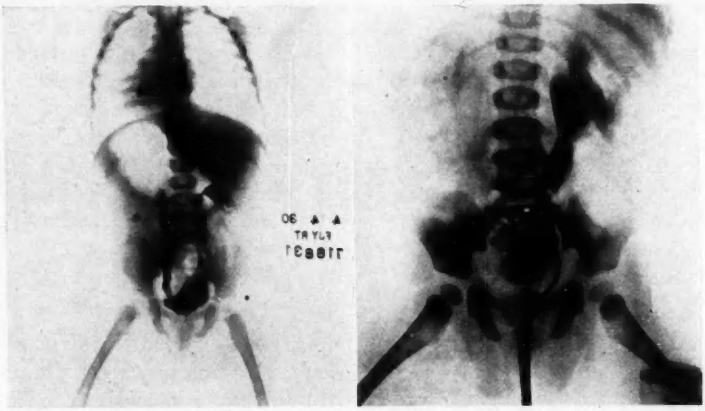

Fig. 1 *(left)*. Bilateral idiopathic dilatation of both ureters without obstruction in a child of three years of age. (Film from the Mayo Clinic.)
Fig. 2 *(right)*. Unilateral atonic angularity and dilatation of one ureter and kidney pelvis. No obstruction of the ureter. Second kidney normal. Nephrectomy and ureterectomy curative.

a large number to appear in this short period of time. Mertz writes that 40 per cent of his chronic cases of pyuria in children were probably the result of congenital anomalies in the urinary tract. Kretschmer, who has made many examinations of the urologic tract in children, reports congenital anomalies frequently. Braasch emphasized their importance when considering urologic conditions in children.

ANOMALIES IN THE URETHRA AND BLADDER

Congenital deformities are infrequent in the female urethra. We have observed only one, a diverticulum. In the male, malformations in the form of flaps or valves may occur in the posterior urethra and interfere with urination. This condition may produce

complete urinary retention. One of us observed a baby, of one and one-half years, whose difficulty in urination occurred in attacks. Eventually this child had complete retention so that he had to submit to an emergency suprapubic cystotomy. At this time I found the neck of the bladder normal, but there was definite obstruction in the posterior urethra, which was easily opened by dilatation with sounds passed from above. Since one congenital anomaly had been found in this child, I insisted that the whole genito-urinary tract should be examined. I was not surprised to find large dilated ureters which may have been acquired and the result of the obstruction in the urethra. We are of the opinion, however, from the character of the pyelo-ureterograms and our experience with similar cases, that the ureters were congenitally deformed.

We emphasize the frequent association of congenital anomalies in the genital tract with those in the urinary tract. When we find one, we expect to find the other. In the urinary tract anomalous conditions are frequently bilateral, so that both ureters and kidneys should always be examined before treatment is started or surgery advised.

We have observed children who have trabeculated bladders with no lack of sensation or relaxation of the posterior urethra and with little or no residual urine. They seem to have difficulty in expelling their urine, but are able eventually to empty their bladders. Many times they have frequency of urination. Examinations for neurologic causes of this bladder difficulty have been disappointing. We have found no definite nerve lesion. We believe that this is a congenital anomaly of the bladder wall, possibly similar to that occurring in the ureters and kidney pelves which we will describe later in this paper.

Exstrophy of the bladder is an anomaly which is infrequently observed. When it occurs the diagnosis of the bladder condition requires no special examination. However, before diversion of the urinary stream is started we suggest complete examination of the ureters and kidneys. Anomalies occurring in the kidneys and ureters will complicate the result expected after a diversion operation so that failure may result.

Incontinence of urine and bed-wetting are frequent complaints of children. These conditions may be caused by congenital anomalies which interfere with the normal innervation of the bladder

neck. Mertz has described and written about infants and children who have spina bifida and who have been relieved by surgical treatment of the lower spine. Children complaining of bed-wetting should always have a thorough and complete urologic examination, because some congenital anomaly may predispose the urologic tract to chronic infection.

We found a partial patent urachus in a child who had other congenital anomalies. Congenital diverticuli of the bladder occur in children, and these may go undetected unless the child has some additional interference or obstruction to the normal outflow of urine through the urethra.

ANOMALIES IN THE URETER

The developmental defects which may occur in the ureter have been especially interesting to us because of their frequency in our series of cases. Hinman has divided these into three types: (1) Anomalies of number, which in his experience are the most frequent; (2) aberrations of insertion, which he finds to be the rarest type; and (3) aberrations of caliber, which he finds holds a mid position, and which are the most interesting of the whole series. In our series of forty genito-urinary anomalies, aberrations of caliber of the ureters were most frequent. These predispose children to interference with drainage from the kidneys with the resulting pyuria, stone formation and possible destruction of the kidney. Ureterocele with pinpoint openings of the ureters into the bladder mucosa have been observed. These small openings may also interfere with drainage from the ureters and kidney pelves. We have observed many children with congenital conditions at the ureteropelvic juncture that have interfered with drainage of the urine from the kidneys. This obstruction is not always produced by a blood vessel. We have found bands of tissue which hold the ureter very tightly in this location. The ureter may not be kinked, but the fixation seems to have some effect on peristaltic action so that the kidney pelvis does not drain well. With this type of fixation of the ureter we have observed the junction of the opening of the ureter into the kidney pelvis to be higher than the lowermost portion of the pelvis, so that the amount of urine retained has gradually increased.

In describing two very interesting cases, John Caulk labelled an

unusual condition of the ureter, "megalo-ureter." Braasch calls this condition an "atonic ureter without obstruction." Beer and Hyman speak of it as the "congenital idiopathic dilatation of the ureter." This condition may be a developmental defect of the muscles of the ureteral wall, or the innervation, or both congenital developmental conditions may exist. Hinman describes a "congenital bilateral obstructing hydro-ureteral angularity" which may be both congenital and acquired, but most of the dilated ureters

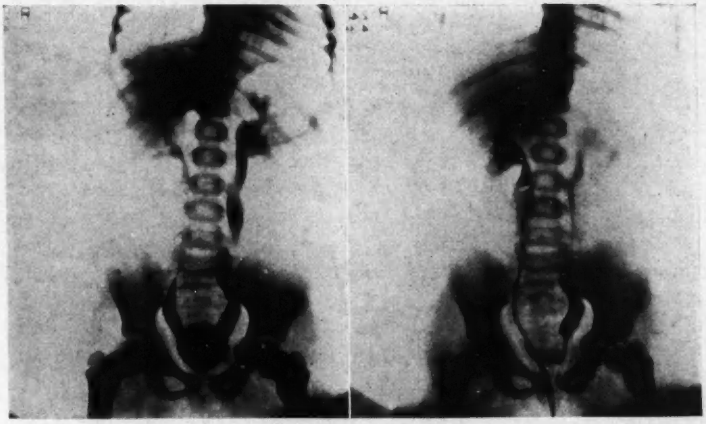

Fig. 3 *(left)*. Bilateral idiopathic dilatation of the ureters. Pyuria only symptom. Catheters difficult to pass because of angularity of the ureters.

Fig. 4 *(right)*. Case same as Figure 3. Note the angularity of the upper right ureter. Catheters would not pass. Plastic operation on the ureter and kidney pelves was not successful.

which he describes, and which he operated upon, were probably the result of an acquired obstruction. Megalo-ureters, or congenital idiopathic dilatation of the ureters are serious conditions. These malformations infrequently give manifestations of their presence, and, therefore, may be overlooked until chronic pyuria develops.

John Caulk has successfully removed obstructions from the bladder neck in children. In some instances this operation has corrected dilatations of the ureter. In our opinion the dilatation of the ureter in these cases was acquired and not congenital. In our twelve cases of congenital idiopathic dilatation of the ureters

there was no obstruction at the bladder neck or at the ureteral orifices. The pelves of the kidneys may be involved as well as the ureters. We believe that this is a defect of development and consequently the ureters never regain their tone no matter what is done to improve them. When the condition is bilateral, operations are of no avail. We have explored the ureteropelvic junction and have found no obstruction and no kinking which would trap the urine in the pelvis. We have attempted plastic operations at the ureteropelvic junction with poor results. We have done the operation described by Hinman for the acquired type of ureteral dilatation, which consisted of shortening the ureters at the bladder junction. The condition was not relieved, as the interference with drainage and the dilatation was present after operation as before. Some of these patients have been temporarily relieved by frequent catheterization, lavage of both ureters and kidney pelves and the ketogenic diet. This improvement, however, has been only temporary, and the drainage, instead of improving, continues to become worse until the patient dies of chronic renal infection or insufficiency. When the condition is unilateral, nephrectomy and ureterectomy may be done with good results. Few observers find children who live more than five years when this condition is bilateral.

ANOMALIES IN THE KIDNEYS

Anatomic anomalies which may be observed in the kidney are double kidneys, on one or both sides, with one or more pelves on each side. As many as six calices may develop in one kidney. All sorts of ectopic, non-migration and non-rotation anomalies may occur. Both kidneys may be fused on one side of the body. In only two instances have we found tuberculosis of the kidney in children, and only once has it been necessary to do a nephrectomy in a child under fourteen years of age. We have access to the records and can examine and re-examine eighty children who are in an institution for the treatment of tuberculosis. Among this group, many of whom may have congenital genito-urinary anomalies, we rarely find evidence of genito-urinary infection.

In 1922 I published a paper, in collaboration with one of my colleagues, concerning urinary lithiasis in infancy and childhood. During our study of the reported cases and our personal series, we did not consider the frequent association of congenital anom-

alies as possible etiologic factors in calculus formation. Forty-three per cent of children under fifteen years of age, with urologic conditions, had calculi of the urinary tract. Interference with drainage and infection of the kidneys seemed to be the major factors in this stone production. Since our more recent study of urologic conditions in children, we wonder how many congenital anomalies occurred in this group of 240 patients with urinary calculi.

Tumors of the kidneys may be polycystic, which is developmental in its origin. Single cysts, usually of the lower pole, may occur. Large hydronephroses may develop from obstructions in the lower tract or at the ureteropelvic junction. Malignant tumors of the kidney occur in children rather frequently. They may grow to a large size before they are discovered. The tumor itself may be the first sign or symptom which attracts the patient, or the mother to the fact that the child is ill, or may have some unusual condition which requires attention. These tumors are usually embryonal in origin and are very malignant.

SUMMARY

Genito-urinary congenital anomalies occur frequently and predispose infants and children to pathologic conditions in the urologic tract. The advent of excretion urography and the more frequent examination of children by the urologist has increased the number of congenital anomalies reported. The incidence of congenital bilateral idiopathic dilatation of the ureters is greater among the congenital anomalies of the genito-urinary tract in children than the present reports indicate. If bilateral, it is a serious condition which is not improved by plastic surgery, but if unilateral, nephro-ureterectomy is curative.

REFERENCES

BEER, EDWIN, and HYMAN, ABRAHAM: Diseases of the Urinary Tract in Children. Hoeber, 1930.
BIGLER, JOHN A.: Trans. Sec. Dis. Child., A. M. A., 150-158, 1928.
BRAASCH, WILLIAM F.: Personal communication.
BUGBEE, HENRY G., and WOLLSTEIN, M.: Jour. A. M. A., 83:1887-1894, (Dec.) 1924.
CAMPBELL, MEREDITH F.: Jour. A. M. A., 92:544-550, (Feb.) 1929.
CAULK, JOHN R.: Jour. Urol., 9:315-330, (April) 1923.
HELMHOLZ, HENRY F.: Jour. A. M. A., 89:1932-1936, (Dec.) 1927.
HINMAN, FRANK: Arch. Surg., 18:21-62, (Jan.) 1929.

KRETSCHMER, HERMAN L.: Jour. Urol., 18:433-457, (Nov.) 1927.
LOWSLEY, OSWALD S., and BUTTERFIELD, PAUL M.: Jour. Urol., 16:415, (Dec.) 1926.
MERTZ, H. O.: Jour. Urol., 19:371-400, (April) 1928.
MERTZ, H. O., and SMITH, L. A.: Radiol., 12:193-198, (March) 1929.
THOMAS, GILBERT J., and TANNER, C. O.: Minn. Med., 5:147-152, (March) 1922.

ANOMALOUS RELATIONSHIP OF THE RIGHT URETER TO THE VENA CAVA

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Having observed at operation two cases of right-sided hydronephrosis, which were caused by the ureter's passing completely around the inferior vena cava, we have thought it advisable to present these two case reports and, at the same time, present the embryologic anomaly that was at fault.

It is of interest that this condition is due to a venous anomaly, and not to a renal-ureteral anomaly. The literature on the subject is exceedingly brief. Roger Graves,[1] in 1922, first called attention, in urologic literature, to the possible existence of this anomalous development, having met its occurrence in experimental surgery on cats. His review of the embryology productive of this anomaly was based on Huntington and McClure's[2] observations of the development of the vena cava in the cat. Graves made a most careful search of the literature and was able to find three cases observed in man, each of which had been found at autopsy. Since Graves' article, the subject has been completely developed by studies on the embryology of the vena cava in the human embryo by McClure and Butler[4] in 1925, from whose comprehensive work we will take some illustrations and the liberty of extensive quotation.

In 1934, at the American Urological Association meeting, Kimbrough[3] reported a case as found at operation. We had experienced our first case before Kimbrough's report, and our second case immediately after his report; but to him belongs the credit for first publication, as well as for the most remarkable happy outcome, for he saw fit to section the ureter, to disengage it from around the vena cava, and to re-anastomose it, and save the kidney's function. It was impractical, in either of our two cases, to attempt to save the kidney, as each had become seriously infected by the time operation was performed.

The mild degree of obstruction suffered by these patients is evidenced by the fact that each had reached full adult development and middle life before competent studies were performed. The con-

genital origin of the obstructive uropathy is beyond question, and, if the kidney is to be saved, an early appreciation of the anomaly, with diagnosis and operative correction, is imperative.

The four reported cases, and the two which we now add, seem

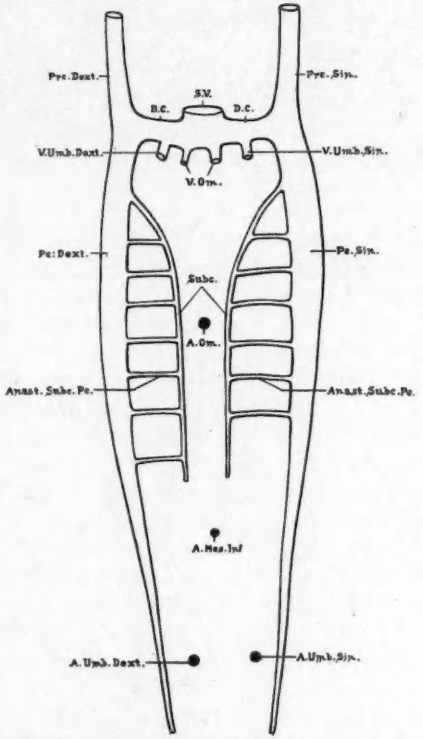

Fig. 1. The two earliest units in development of vena cava. (Pc.) Postcardinal veins. (Subc.) Subcardinal veins with anastomotic branches.

to be the total observation of this unusually interesting anomaly in man, for we have found no further reference to it in our search of the available recent literature. That it is exclusively a right-sided lesion will be brought out by a presentation of the embryology, and

from our experience we feel that we can add a point of diagnostic value.

EMBRYOLOGY

The plan of development of the adult vena cava is dependent upon the union of the three venous channels, which are known as

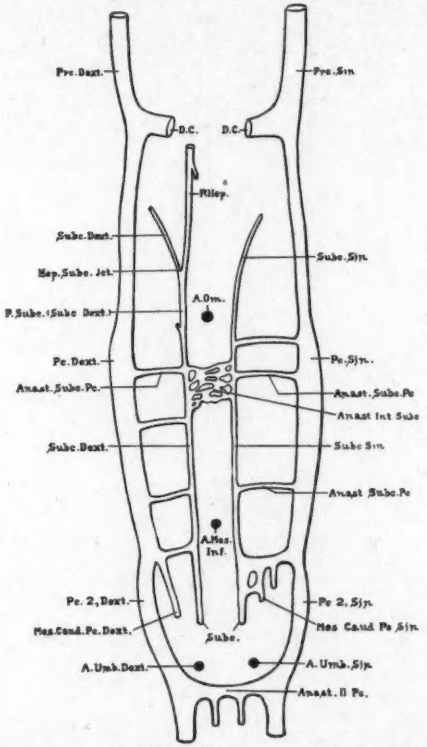

Fig. 2. The right subcardinal vein has developed independent drainage through (P. Hep.) pars hepatica. An anastomosis has developed between the subcardinal veins (Anast. int. Subc.).

the postcardinal, subcardinal and supracardinal veins, in order of their appearance during fetal life.

As a result of the studies of McClure and Butler, one finds the postcardinal and subcardinal veins, only, appearing in the 4 mm.

embryo, the first specimen under observation. At this stage of development there is no evidence of the permanent kidneys, and the postcardinal veins are of greater size than the subcardinal (Fig. 1). The latter empty into the cephalic end of the postcardinal veins, and are joined caudad to this by numerous anastomotic branches.

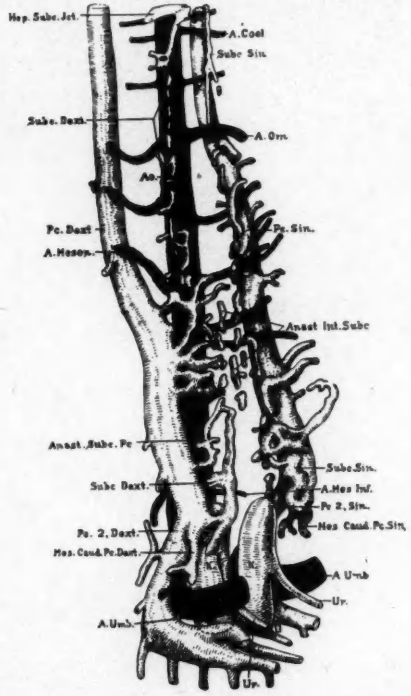

Fig. 3. Reconstructed model of an 11 mm. human embryo. The kidneys (K.) are seen lying mesial to the postcardinal veins and umbilical arteries.

The permanent kidneys are first seen in the 11 mm. embryo, appearing mesial to the umbilical artery and the postcardinal vein, the caudal end of which is angulated (Fig. 2). Also, two outstanding changes are noted in the development of the subcardinal veins—first, an anastomosis between these two veins, and second, direct drainage into the duct of Cuvier through the pars hepatica (Fig. 3).

In the 15 mm. embryo we find many changes (Fig. 4). There is a gradual shifting of the venous circulation from the postcardinal

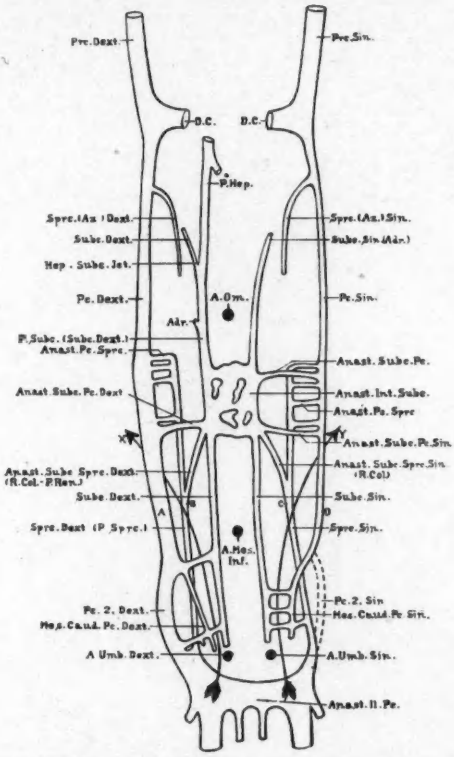

Fig. 4. Diagram of the venous system of a 15 mm. human embryo showing the first appearance of the supracardinal veins (Sprc.). The units from which the adult vena cava develops are shown here as the (P. Hep.) pars hepatica, (Subc. Dext.) right subcardinal, (Anast. Subc. Sprc. Dext.) right subcardinal-supracardinal anastomosis and (Sprc. Dext.) right supracardinal. The arrow demonstrates the route which the kidney takes in its ascent to the renal fossa.

to the subcardinal veins, which is depicted by a narrowing of the post-cardinal veins, more manifest on the left side, the extreme caudal part being completely atrophied. The supracardinal veins

have also appeared, completing the three groups from which the adult vena cava develops. An anastomosis has formed between the subcardinal and supracardinal veins, lying mesial to the cephalic end of the permanent kidney. This is termed the pars renalis and enters into the formation of the renal collar on the right side. At this stage the right kidney has advanced cephalad and lies mesial to the postcardinal vein, peripheral to the subcardinal veins and

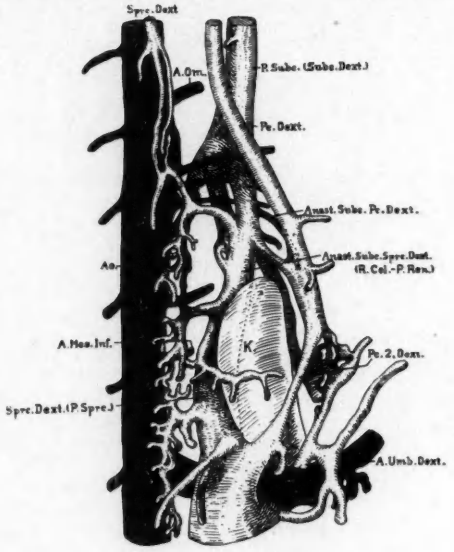

Fig. 5. An interesting dorsal-lateral view of a reconstructed model, showing the renal collar on the right side. The kidney may be seen mesial to the postcardinal vein, in a position to advance behind it to the normal renal bed in the loin.

pars renalis, and ventrolateral to the supracardinal veins. All of these, with their anastomoses, form the perimetanephritic ring, or renal collar (Fig. 5).

Normally, the adult vena cava develops from fetal portions of the elaborate venous display represented at this stage by the pars hepatica, pars subcardinalis, pars renalis and pars supracardinalis. (Fig. 4.)

In the 22 mm. fetus the abdominal portion of the postcardinal

veins has completely atrophied, shifting the circulation to the subcardinal and supracardinal veins, with their anastomoses, and the renal veins can be seen arising from the pars renalis (Fig. 6). In

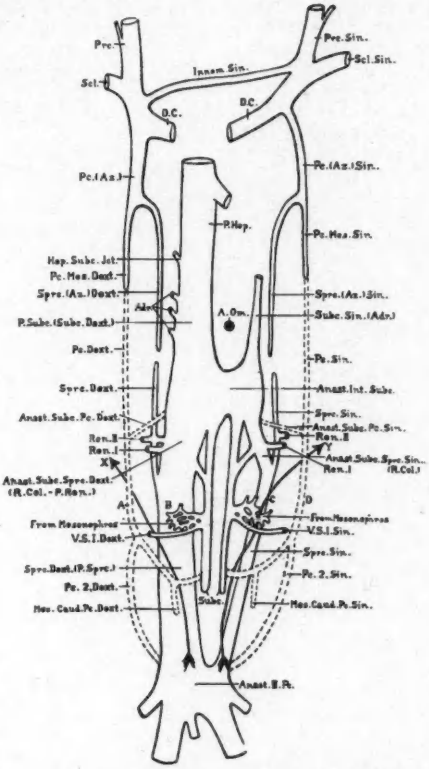

Fig. 6. Diagrammatic representation of the venous system in a 22 mm. fetus. The arrows represent the route of migration of the kidneys through the venous ring to their normal position in the loin. Atrophied vessels are indicated by dotted lines.

or about the twentieth week of fetal life the kidneys, after migrating through the venous ring, attain their normal position in the loin; and the atrophied vessels leave the ureters free of any vascular entanglements, so that, as the fetus straightens, the ureters will

be pulled away from the ventral surface of the vein, to lie in their normal beds lateral to the adult vena cava (Fig. 7).

This, therefore, leaves only one supposition as to the embryo-

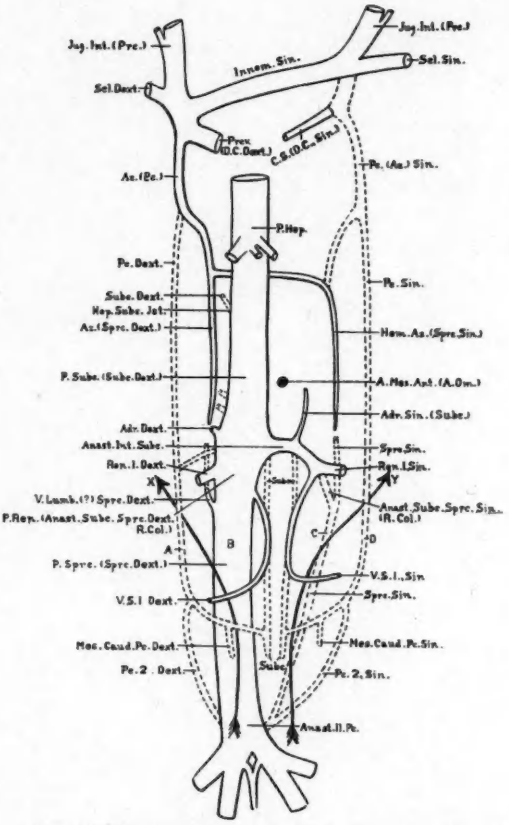

Fig. 7. Diagram of the normal venous system of adult man.

logic etiology of the anomalies which we are reporting; namely, the postcardinal system failed to atrophy, and, instead of the circulation changing to the subcardinal and supracardinal veins, the reverse

occurred, with the postcardinal vein remaining as the main channel from which the adult vena cava developed.

From a study of the tributaries entering into the development of the vena cava of the adult cat (Fig. 8), fifteen possible venous

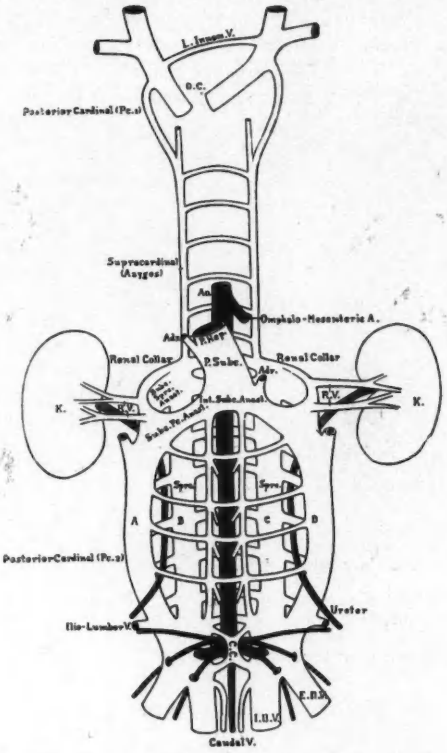

Fig. 8. Composite diagram of the embryonic veins of the domestic cat (Felis domestica). Huntington and McClure.

anomalies have been postulated, all but three of which have been found in the adult cat. A survey of the literature by Huntington and McClure[2] shows that a persistence of the right postcardinal vein is the only anomaly of this embryonic vascular system to have been found in adult man.

Case 1.—Mrs. A. M. F., aged twenty-five, white, female, was admitted February 10, 1932, to the Hospital of the Women's Medical College, service of Dr. J. S. Rodman, with complaint of hematuria.

The patient had never been ill. At the age of twelve years she fell and injured her spine in a roller skating accident, at which time she was admitted to a hospital and had a cast applied for an unrecorded period of time. She had been married four years and had one child twenty-eight months old. There had been no miscarriages, no men-

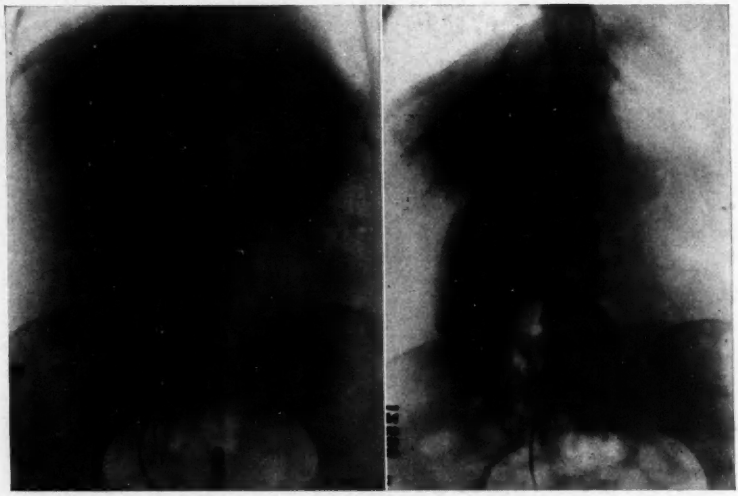

Fig. 9. X-ray (*left*) shows atypical position of ureteral catheter hugging the spine as it passes under the vena cava. Retrograde pyelogram (*right*) made previous to any operative procedures shows an enormous dilatation of the ureter just before it passes under the vena cava.

strual irregularity. Appetite had been good; bowels were regular; there had been no indigestion; no pain on urination, but she reported that her urine had always been cloudy, with a nocturia of once.

The patient stated that her right kidney had been bothering her for a long time, with pain in the right kidney region, off and on, for four years; and six years ago she had a hemorrhage, passing blood in the urine for two voidings. Sometimes she had pain in the bladder, which would shoot up toward the right kidney. Since her baby was born, twenty-eight months ago, she had seen blood in her urine on seven occasions, the last only two weeks ago.

After studies, including a pyelogram (Fig. 9) and an intravenous urogram (Fig. 10) a diagnosis was made of "right hydronephrosis

and right hydro-ureter, probably due to adhesions about the middle portion of the ureter, or to new growth." The left ureter, pelvis and kidney were well within normal limits, and there appeared to be bilateral equal concentration of the injected iopax. A roentgenogram of the chest and spine gave a diagnosis of marked deformity of the chest, but no characteristic pathologic change was demonstrable. Examination of the spine revealed a marked scoliosis, the concavity toward the

Fig. 10. Urogram made previous to any operative procedures again shows the redundant, dilated right ureter. Medial to the sacculated ureter a narrow shadow can be seen curving upward and then toward the midline. This is the position of the ureter passing under the vena cava.

left side, as likewise a deformity of the third cervical vertebra, characterized by narrowing of the body, due either to congenital absence or to an old destructive process. There was also a narowing of the left side of the bodies of the eighth and ninth dorsal vertebræ, again suggesting an old quiescent process. There was marked widening of the seventh rib, posteriorly, on the left side, suggesting an old osteomyelitis, and an apparent bony union between the seventh and eighth ribs on the left side posteriorly. It was judged that these processes

were all the result of an old osteomyelitis. The leukocyte count was 9,000, red blood cells, 3,710,000. Urinalysis findings indicated a normal condition except for a few epithelial and white blood cells. The patient also suffered from a marked tonsillar lesion, and at this admission had a tonsillectomy performed. She was discharged on February 19, 1932.

The patient was admitted to the hospital a second time, February 24, 1932, for attention to the hydronephrotic right kidney. She reported that the pain had been severe for the past four days and required the administration of morphine. On the evening before admission she had an attack of intense pain, lasting all night; but this pain stopped rather suddenly while she was on the way to the hospital. On admission cystoscopic examination was made and catheter passed into the right ureteral orifice, 25 cm. Through it drained a turbid, foul-smelling urine, but as drainage ceased the catheter was removed. There was a severe chill on her return to the ward, with a temperature of 104°, and six hours later a second chill occurred, after which her condition steadily improved. A pyelogram taken at this time is reported as showing the catheter past a point thought to be the site of obstruction in the previous studies. Ureter and kidney were filled and showed a marked hydro-ureter and hydronephrosis. The patient was discharged on March 3, 1932, having been advised to return for the removal of her right, hydronephrotic kidney.

On July 6, 1932, the patient was admitted to the hospital a third time. She had been in remarkably good health, having had no further manifestation of infectious character, and returned for the removal of her right hydronephrotic kidney. There had been no dysuria; no subcostal or renal pain. On physical examination there was definite tenderness in the region of the right kidney, and an odd mass could be indefinitely outlined.

Operation was performed July 8, 1932, by Drs. J. S. Rodman and F. Fetterman, using gas anesthesia. Incision was made for a right nephrectomy, and on entering the retroperitoneal space, a large hydroureter was isolated. This was opened and found to be filled with clear, straw-colored urine under great tension. After emptying this, the opening was sutured. Attempt to free the kidney was made, and met with increasing difficulty; and the operation was temporarily suspended while the twelfth rib was resected. Further effort to free the kidney resulted in a small rent in the peritoneum, which was immediately closed. After that a tear in the pleura, in attempting to free the upper pole, brought the operation to a point where it seemed wiser to drain and await a secondary nephrectomy, rather than pursue further efforts at freeing an enormous hydronephrotic kidney mass. The patient stood the operation remarkably well, and the wound was closed about two iodoform gauze packs.

The patient had an uncomplicated convalescence, though with an elevated temperature for the seven immediate postoperative days. On

July 12, 1932, examination of the chest by x-ray showed a moderate right pneumothorax. The lung itself appeared to be in good condition. During this postoperative period there was a constant discharge of urine through the drainage tract, which at no time showed any tendency to be purulent.

The second operation was performed July 14, 1932, under gas anesthesia. The incision was slightly opened, gauze drains removed, and kidney found to be much smaller, firmer and nearer normal in appearance. The ureter could not be definitely found, as it was enclosed in a mass of new and old adhesions. New gauze drains were inserted, and it was felt that a ureterotomy had established itself.

On July 18, 1932, as temperature had been normal for the past two days, the drains were removed, and a drainage tube was inserted into the wound. Drainage was still profuse. Another intravenous pyelography was performed, which demonstrated a distinct decrease in the amount of hydronephrosis, and with active and almost equal dye concentration on both sides.

On July 19, 1932, the phenolsulphonephthalein test showed 30 per cent returns in the bladder urine. None was recorded as being returned in fistulous drainage. The patient made an uneventful recovery, leaving the hospital on August 13, 1932, with very slight drainage through a small fistula in a healthy scar.

On October 9, 1933, the patient was admitted to the hospital a fourth time. Interval history showed that within the year since the last discharge she had had intermittent attacks of right renal pain. They had become increasingly severe and prevented her from doing anything but the lightest of work. Pains started in the right iliac region, with feeling distention and discomfort. Mainly they radiated to the umbilicus or down the right anterior surface of the thigh. More often they radiated to the right lumbar region, continuing intense, with constant throbbing. These were followed by a feeling of heaviness in the right subcostal area, and the pains lasted from a few hours to three days. They were relieved only by continued rest in bed and were aggravated by motion, deep inspiration, or being in the upright position. Occasionally, vomiting accompanied these attacks. There had been hematuria present on three occasions in the past year. Micturition was attended with no pain, burning, tenesmus or frequency. The patient had gained five pounds in weight, appetite was good, and there was marked tendency to constipation, which increased during a period of pain.

Physical examination revealed a protuberance in the abdomen greater on the right than on the left. There was no rigidity, but general distention, and tenderness on deep pressure over the entire right side. There was an indefinite mass in the right iliac region, extending laterally into the loin space. The mass varied with position. The scar from the previous incision was healthy and completely healed. Intravenous urograms at this admission showed both kidneys to be

functioning quite well. There was more clubbing of the calices of the right kidney than when previously seen, as well as an increase in the hydronephrosis. The left kidney pelvis was within normal limits.

The patient was discharged on October 22, 1933, as she had developed a furunculosis of the right side of the face, and was sent home until this subsided.

The fifth admission to the hospital was on November 6, 1933. The patient was restudied, urogram (Fig. 11), as well as blood chemistry,

Fig. 11. Intravenous urogram made prior to the last operation showing increasing destruction from infection and back-pressure.

being done. She had never presented an elevated B. U. N. and her phenolsulphonephthalein return was 85 per cent in two hours. Temperature was normal; urine negative except for a few epithelial cells; blood sugar 75 mg. per 100 c.c.; and a repetition of her intravenous urogram showed no change from the previous observation. She was allowed to go home on November 14.

The sixth admission was made November 26, 1933. There was no change in the patient's condition, and a recheck of her physical and laboratory findings showed her to be in satisfactory shape for operation.

The third operation was performed by Drs. Randall, Rodman and

Campbell on November 29, 1933. The patient was given 150 mgm. of neocaine intraspinally. Incision was made anterior to the previous one, with an excision of the old scar. The anterior portion of the incision was carried down purposely to enter the unmolested retroperitoneal tissue, in an effort to find the ureter in the lower part of its middle third, and, from this undisturbed portion, to attempt to trace its ramifications from there upward. This was a fortuitous step, for without

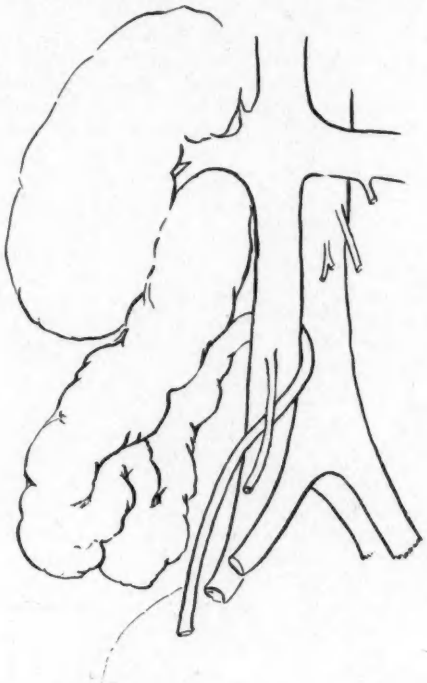

Fig. 12. Schematic outline of condition found at operation in Case 1.

difficulty the ureter was found just above its crossing of the iliac vessels and was clamped and cut, the distal portion being tied off and allowed to drop back. With a clamp on the proximal end, the ureter was traced upward until it was found to be increasingly involved in a peri-ureteritis and closely attached to the vena cava. Desisting from this for a moment, the ureter was isolated in one of its redundant and dilated loops above the evident point of obstruction, for the portion

previously isolated was not dilated or diseased. Having isolated one loop, it likewise was clamped and severed, and the portion which apparently went downward was carefully dissected away until it was found to be passing directly under the vena cava. At this stage a section of ureter approximately 8 inches long was in our hands, with a Kelly clamp on each end, and with its middle portion passing directly around the vena cava. Further dissection revealed that where it recrossed the vena cava anteriorly, it passed under the ovarian vein at its point of juncture with the vena cava. The portion of the ureter above the vena cava was dilated. The portion below was not dilated (Fig. 12). One could pick up these two ends and lift the vena cava until it was completely flattened and without blood, and then, on releasing such traction, could see the blood again fill its lumen and the vessel distend to its normal size. This was repeatedly demonstrated to various attending physicians and students. In order to prevent drawing an unnecessary amount of tissue from under the vena cava, the ureter was again clamped and severed as close as safe to the vena cava on the upper portion. The distal end was ligated, and then, with traction on the lower portion of the ureter, it was easy to separate the ureter from the vena cava by gently rolling the latter over so that the separation could be done under vision of the eye. This portion of the wound was then temporarily packed and held aside with retractors. The incision was developed upwards so as to reach the costovertebral angle, and, with traction upon the then proximal end of the ureter, this greatly dilated portion was delivered and traced up until it entered the renal pelvic portion. As this was high and difficult to reach, it was crushed with a clamp and ligated as high up as could be safely reached. This disposed of all of the ureter from the renal pelvis to where it was first ligated at the bony pelvic brim.

Realizing that nothing but a subcapsular nephrectomy could be performed, an immediate incision was made into the hydronephrotic renal mass at about the point of previous drainage. It was easy to strip the kidney from its capsule, as the capsule was between 4 and 6 mm. thick at this point of entrance. The kidney mass reached high up under the costal margin, but it was possible to place clamps upon its pedicle and excise the mass without loss of blood. Two clamps on the pedicle vessels were ligated and safely removed. After this was done, there appeared to be a further kidney mass in the extreme upper portion of the capsule. This was lifted, clamped and removed, and the clamps successfully ligated and removed. This latter mass was a little difficult to explain. It represented a mass about one-third the size of the kidney already removed, but was unquestionably a portion thereof. It appeared to have a second vascular pedicle, but no other anomaly was found to be present. It certainly was not a reduplicated kidney, and at no time, with quite competent study, was there ever a suggestion of a reduplication of the ureter. The latter portion of the operation required the administration of gas and oxygen. The wound was closed

about competent gauze drainage. Duration of operation was two hours.

An extensive study of the tissue removed showed nothing unusual in the pieces of ureter except mild inflammatory reactions. The kidney tissue itself showed rather competent renal units, but again with inflammatory reaction and considerable fibrosis.

The patient's postoperative convalescence was extremely satisfactory. Her temperature elevated to 101° twenty-four hours after operation, but reached normal and remained so from the fifth postoperative day on. Her surgical dressings were easy, and the drains were completely removed by December 16. She was sitting up in bed by December 21 and was out of bed three days later. On the 25th her wound was closed, her dressings dry, and the fistulous tract practically closed. She was discharged from the hospital on December 27 in satisfactory postoperative condition.

Case 2.—Mrs. G. M., aged fifty-five, was admitted July 14, 1934, to the Abington Memorial Hospital, with complaint of hematuria and low abdominal pain. She had typhoid fever at thirty-eight years of age. She had had two miscarriages and eight normal pregnancies. There was no history of pyelitis associated with the pregnancies.

The patient had been enjoying good health until the day prior to admission, when she suddenly experienced a sensation in her abdomen as though something had burst. This was followed by hematuria, dysuria, frequent micturition and tenesmus. Following the first attempt to void she developed pain in the lower abdomen and a dull pain in the right loin. There were no gastro-intestinal symptoms and no history of a fall or trauma could be obtained.

The patient was a short, stout, flabby individual whose skin was pale and clammy. The facial expression, skin and paled mucous membranes suggested a moderate state of shock. Blood pressure was 80/54. Physical examination revealed nothing abnormal except the abdomen, where suprapubic tenderness and rigidity were elicited, the tenderness extending up along the course of the right ureter to the right loin. The laboratory findings were as follows: Urine filled with blood, albumin present, and sugar 1 plus; hemoglobin 81 per cent, leukocytes 9,800, polymorphonuclears 87, lymphocytes 12, eosinophils 1: B. U. N. 31, blood sugar 254, chlorides 583, plasma CO_2 51 per cent. Treatment for shock was immediately instituted and the patient responded readily.

On July 16, 1934, the first cystoscopic examination was attempted, but the bladder was so completely filled with blood clots that a successful study could not be made. Bladder irrigations were carried on for two days before studies were again attempted.

At cystoscopic examination on July 18 the remaining clots were removed, and bloody urine could be seen spurting from the right ureteral orifice. A No. 7 catheter was inserted 25 cm., where an impassable obstruction was met. Bloody urine drained rapidly from the

catheter, and the urine obtained from the right kidney contained blood and pus. A pyelogram was also made.

A catheter was allowed to remain in the right ureter for forty-eight hours' drainage, and before it was completely removed a pyelo-ureterogram was made (Fig. 13). Following this the urine gradually cleared, and a differential phenolsulphonephthalein test was possible; the dye appearing from the right kidney in twenty minutes, with a concentration of 3 per cent in thirty minutes following appearance, and

Fig. 13. Retrograde pyelo-ureterogram showing dilatation of the ureter and pelvis due to obstruction and infection. The lumbar ureter can be seen curving under the vena cava at the fourth lumbar vertebra.

from the left kidney in nine minutes, with a concentration of 10 per cent in a thirty-minute specimen.

The patient's condition had gradually improved, and on August 6, 1934, twenty-two days after admission, a phenosulphonephthalein test showed 3 per cent output from the right kidney and 35 per cent output from the left kidney, in thirty-minute specimens. At this time the B. U. N. was 11 mg. per 100 c.c. of blood, and the blood sugar 188 mg. per 100 c.c. of blood.

Operation was performed August 8, 1934. The kidney was exposed through an extraperitoneal approach, but with difficulty because

of a mass of adhesions to the renal capsule. The kidney was large and flabby, and the parenchyma studded with abscesses. The pelvis was distended and firmly adherent to the peripelvic fat. The upper ureter was dilated and, on dissection, was found to pass downward for about 4 cm., and then curve upward and inward. At this point the ovarian vein was attached to its anterior surface and was torn, necessitating ligation. Further dissection was impossible because of an intimate attachment of the ureter to a large vessel, which was found to

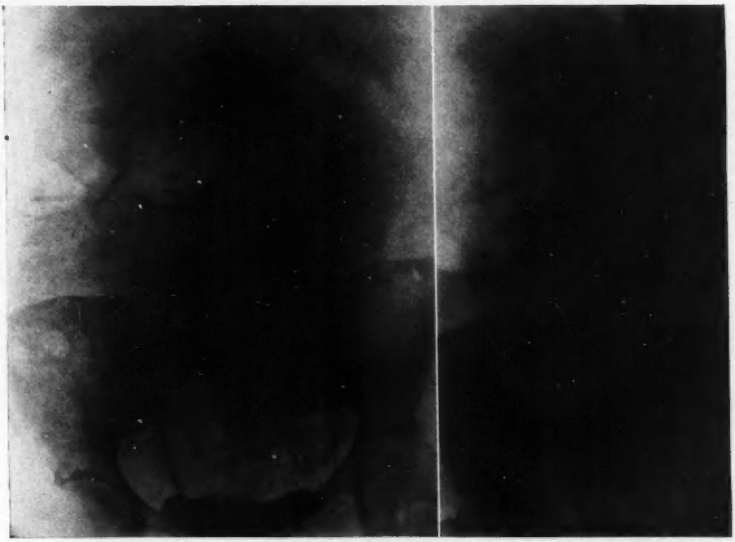

Fig. 14. Postoperative pictures taken with a catheter in the right ureter. Sodium iodide may be seen trailing through a sinus from the stump of the ureter to the loin wound. The picture on the right is an oblique view taken at the same sitting. This shows the ureter close to the spine while the normal ureter in this position falls away from the vertebræ. This, it is felt, is a characteristic diagnostic finding for this type of anomaly.

be the vena cava. The ureter was clamped at this point and severed, following which the kidney was removed. The distal ureteral stump was then opened, and a slightly curved stone forceps inserted down its lumen for 5 cm., where it met an obstruction. The tip of the forceps could be felt through the ureteral wall at the inner aspect of the vena cava, the ureter having passed under this vessel. From this point the ureter was traced downward and was found to pass across the anterior surface of the vena cava to its outer edge, and then on into the pelvis, assuming its normal position at the pelvic brim.

The patient made a very slow recovery, and developed an infected sinus in the wound, healing of which was difficult to obtain.

The failure of the sinus to close prompted the making of a ureterogram to determine its connection to the ureteral stump (Fig. 14). The oblique view is most interesting, because it presents a characteristic diagnostic point for this type of anomaly. In the normal position, the ureter is seen to fall away from the spine, but when it passes behind the vena cava it is observed impinged against the lower lumbar spine.

SUMMARY

1. We have reported two cases where an obstructive nephropathy with pyonephrosis was caused by the passage of the ureter completely around the vena cava in its descent to the bony pelvis.

2. The literature contains the report of three cases as found at autopsy, and one as found at operation. To this latter group we now add our two observations.

3. The anomalous embryologic development responsible for this condition is presented.

4. A new, and highly suggestive, clinical sign is first reported herein, which should aid in the pre-operative diagnosis of this condition; i.e., the peculiar position that the ureteral catheter bears to the vertebral column when lateral roentgenograms are taken.

BIBLIOGRAPHY

1. GRAVES, R. C.: Anomalous relationship of right ureter to the inferior vena cava. Jour. Urol., 8:75-80, (July) 1922.
2. HUNTINGTON, G. S., and MCCLURE, C. F.: Development of veins in domestic cat, etc. Anat. Rec., Vol. 20, 1920.
3. KIMBROUGH, J. C.: Report at meeting of American Urological Association, 1934.
4. MCCLURE, C. F., and BUTLER, E. G.: Development of the inferior vena cava in man. Amer. Jour. Anat., 35:331-383, (July) 1925.
5. SABIN, FLORENCE: Carnegie Contributions to Embryology. Vol. III. On the Fate of the Posterior Cardinal Veins.

DISCUSSION

DR. JOHN R. CAULK (St. Louis, Mo.): I should like to pay my respects to Dr. Thomas for bringing up the subject of urology in children. I think we have gradually come into our own in pediatric urology but find ourselves a little confused in the interpretation of urographic pictures. Ultimately, however, we will solve this among ourselves.

We are relying, I fear, a little too much on one particular thing to help us in the final summing up of the problems. This is our main fault at the present time. We should subject these children, as a rule, to the same routine urologic studies as we do the adults and they tolerate it just as well, if not better.

There are several things that we as urologists must stress. I have noticed in our studies at the Children's Hospital in St. Louis that physicians rarely catheterize to determine the presence of residual urine. Most of these children who have urinary symptoms have never been catheterized and doctors have not suspected a residue, yet we find it frequently. I suggest that whenever there is bladder irritability with frequent urination in children one should catheterize to determine the presence of residual urine. The cystogram affords a most valuable method of determining the true nature of the lesion. While intravenous urography is at times a marvelous help, it is not without its faults. It is difficult to differentiate whether a ureteral dilatation is the result of excretory retention or ureteral regurgitation, hence the site of the lesion is missed. We get very confusing interpretations, and I will show you one picture to illustrate this point.

(Slide) This is an outline of the pelvis of a kidney following intravenous urography. The boy had a large fluctuant mass in the left side which suggested clinically a hydronephrosis, yet, as you can observe, the pelvis and calices are entirely normal.

(Slide) A retrograde pyelogram of the same case, taken the next day, reveals a tremendous hydronephrosis with stricture at the ureteropelvic juncture.

This indicates the danger of relying on intravenous urography.

Obstructions at the ureteropelvic juncture occur less frequently than other ureteral obstructions, but they are more destructive. They usually produce large hydronephrotic or pyonephrotic sacs which require nephrectomy. A few lend themselves to plastic procedures. I have performed plastic operations in five such cases with very gratifying results in four; the fifth case was unsuccessful. The method employed in these cases consisted in resection of the strictured area and resection of the pelvic sac with re-implantation of the ureter into the dependent part of the pelvis, fortifying the anastomosis with a catheter splint, bringing the catheter out through the cortex of the kidney and inserting another catheter through the substance of the kidney into the pelvis to insure thorough drainage. Very few sutures should be placed at the anastomotic juncture.

(Slide) Obstructions at the intramural ureter are susceptible to dilatation and many children with such lesions can be kept well through cystoscopic manipulations. The dense strictures require surgery and I am convinced that the operation which I described to this Association in 1919 (the transposition operation) is the one of choice. It is intravesical, very simple and consists of removing the scarred intravesical ureter, allowing it to be attached to the bladder at its entrance. It is far superior to ureterovesical anastomosis which so frequently results in contracture and renal death.

(Slide) These bilateral ureteral and pelvic dilatations are invariably the result of obstruction either at the lower end of the ureter or, more commonly, at the bladder neck, with incompetency of the ureteral valves and regurgitation. I fail to see why one should struggle to explain them on a neurologic or infectious basis. They are mechanical.

I urge investigation in these children, particularly cystoscopic study.

We are using anesthesia in only 35 per cent of our cases in infants. If one is patient and secures the confidence of the child he will find that the majority do not require general anesthesia. If an anesthetic is necessary it should be given only during instrumentation and should be removed in a few moments so that functional studies and pyelographic determinations may be conducted with accuracy and safety.

DR. LEON HERMAN (Philadelphia, Pa.): I believe Dr. Thomas did not mention a case of hypoplasia of the ureter. In this connection I should like to report the interesting case of a Philadelphia policeman who came to us with a history that he had had a stone removed from a diverticulum of the bladder. We have in Philadelphia a chief police surgeon, Dr. Hubley Owen, who is an excellent general surgeon. Dr. Owen sent this man to me with the report that he had taken a stone out of a diverticulum, but that it had recurred. The x-ray showed a bulb of stone projecting into the bladder and three faceted stones extending in the line of the left ureter. Differential studies, intravenous urograms, et cetera, showed no kidney function on the left side. The question was whether to expose the left kidney, with the idea of doing a ureteronephrectomy, or to expose the pelvic ureter. I decided to expose his ureter, which was found to be hypoplastic, about 2 inches in length. This patient had stones in a hypoplastic ureter due to reflux. I think it is a rather rare congenital anomaly and possibly unique as far as the stones are concerned.

DR. WILLIAM E. STEVENS (San Francisco): I would like to stress the importance of one organ that we are apt to overlook in the consideration of the etiology of pathologic conditions of the upper urinary tract in infants and young children, that is the urethra. Congenital obstructions due to strictures are common in both sexes, and diaphragms or valves, although more often seen in the male urethra, have also been found in that of the female. I believe that many children die at an early age and others are born dead as a result of congenital urethral obstruction. Hydro-ureters and hydronephrosis with destruction of the kidneys are found at autopsy in these cases.

DR. BENJAMIN S. BARRINGER (New York City): I should like to speak very briefly on Dr. Thomas' paper and to congratulate him on his fine results. In the case that I want to report the result was not so nice, but it illustrates the extent to which these congenital anomalies may go and it also gives a hint as to the congenital cause of multiple cystic bilateral kidneys.

This patient was a baby whom I saw when ten days old. She had never passed any urine as far as the nurses could find out. She

was delayed in coming to us because the nurses were not sure. When I saw her first she had generalized edema all over the abdomen, extending up in her chest and upper thighs. She had one large kidney, the right, which could be felt and nothing could be felt on the other side. I did a rapid nephrostomy without any trouble in going through the edematous kidney tissue, and as far as I could see she had a dilated pelvis. I was criticized the next day or two because I wouldn't tackle the other kidney. She came to autopsy in about five or six days and edema had occurred after nephrostomy. A great deal of urine was found at autopsy, and there was on the left side an infantile kidney with a ureter about half way down and then it was a mere string as far as the bladder. There was multiple cystic disease of the left kidney. On the right side she also had a cystic kidney with the ureter going all the way down to the bladder, but for a stretch of about 3 inches it was absolutely sclerosed. There was no chance of doing anything whatsoever, as far as I could see, to correct these anomalies.

Dr. George R. Livermore (Memphis, Tenn.): I have always been rather surprised at the ignorance of the profession generally about urologic conditions in children. There are two contra-indications to the use of the cystoscope in the child, a low phenolsulphonephthalein output and a high non-protein nitrogen and creatinin. If these two tests are fairly good, we can make cystoscopic examination of all children regardless of their age, unless the cystoscope cannot be passed. I have used the cystoscope on a baby girl as young as three days old and a boy as young as four weeks. With the proper instruments and care, it has been my experience that the reaction following cystoscopy in children is much less than in adults.

There is a point that Dr. Thomas made to which I do not subscribe. He said that in many of these cases of dilated ureter accompanied by great destruction and dilation of the ureter and the kidney pelves, there isn't much we can do and these patients usually die within five years. I had a boy who was five years of age about ten years ago who weathered an attack of measles, and his doctor found a little albumin in the urine which he considered was the result of measles. The child recovered from the measles and while playing in the yard about two or three weeks after the

measles attack stumbled and fell. Around a flower bed was a coping made of bricks set in an angular position. He hit himself in the suprapubic region on one of those bricks and voided bloody urine and I was called in. The kidney showed ureters greatly dilated and tortuous and a bilateral hydronephrosis. That child was five years of age and the ureters were tortuous sacs that looked exactly like small intestines. When I tried to catheterize the child the ureteral orifice looked about the size of a large lead pencil and the ureteral catheter would pass only 1 or 2 cm. The orifice was indurated and there wasn't any elasticity to it. It seemed to be a hard, contracted ring. We took a fulguration electrode and cut the induration about each orifice, and dilated that child at intervals of every two weeks for quite awhile. He is alive and well today, ten years afterwards, and he looks like a really healthy child. I would like to make a cystoscopic examination but the family do not want any more manipulation done. He is perfectly well apparently, going to school, playing football and having a good time like every other child.

Dr. Gilbert J. Thomas (Minneapolis, Minn.): I want to thank Dr. Caulk and the other gentlemen for discussing my paper, and to emphasize the necessity of the urologist's coöperating with the pediatrist in the diagnosis and treatment of urologic conditions in children. Of course, Helmholz's work with the ketogenic diet focuses the attention of the urologist somewhat upon the pediatricians; they were apparently the first group that were able to control infection in the urinary tract. This method of controlling infection is now being used with the adult.

Cystoscopy, as Dr. Caulk has told us, is easy with children. Reactions are not severe. I usually use bromides by rectum or chloral for the first cystoscopy. Unless they have very irritable bladders, cystoscopy can be performed on little girls repeatedly with a pledget of cocain introduced into the urethra. They have practically no pain and will submit to repeated cystoscopies.

I know that Dr. Caulk has made cystoscopic examination of the little boy that we have seen three or four times and I have done so two or three times. We were able to do it with the introduction of alypin or metacain in the urethra, waiting long enough for the

anesthetic to take effect, and the child would permit manipulation for fifteen or twenty minutes.

I have never observed a ureter like the one Dr. Herman reported. I have found single kidneys a few times, but I have never been able to observe a ureter of that type.

Concerning obstructions in the urethra mentioned by Dr. Stevens: In my paper I described an operation on a five-months' old boy who had these valves which frequently occur. However, he had a retention of urine intermittently. He would pass urine for a time and then he would not pass it for two or three days. Eventually this obstruction, probably because of continuing infection, became complete and necessitated a suprapubic cystoscopy with dilation from above, which was done.

In going over this subject I find that the enlargement of the verumontanum is frequently mentioned as causing obstruction in male urethras.

ROENTGENTHERAPY FOR RECURRING BLADDER TUMORS OF LOW MALIGNANCY

A PRELIMINARY REPORT

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A few years ago one of us stated that bladder tumors of grades I and II should be attacked with the conviction that they are so curable as scarcely to deserve to be classified as malignant. Today we wish to modify that doctrine. We are aware of the "malignant papilloma," increasingly aware, as our patients return with tumor after what seemed efficient fulguration or radon implantation. *Single tumors* of grades I and II, we feel, may be successfully attacked in many ways: by fulguration, by radon implantation, by resection. If some of the tumors recur, they are thereby to be classed as multiple. *Multiple tumors recur* after any treatment. It has been estimated that recurrence occurs in half the multiple cases. Therefore, one need not apologize for suggesting the use of x-ray therapy in the hope of controlling multiple papillary carcinomata of the bladder, without reference to the permanence of such control. That, the future will decide. We are emboldened the more because we have recently employed a form of x-ray therapy that does not cause x-ray sickness or grave skin irritation. Indeed, bladder rather than skin sensitivity limits our therapy. Furthermore, tumors of low malignancy, of slight cellular differentiation, are especially vulnerable to this treatment.

Before attempting the description of this method, and narrating and illustrating the results obtained, we must, however, insist upon one essential feature of our work. It has not been delegated to a technician. It has been conducted by Doctor Hocker, who, after conference upon the clinical features of the case, treats the patient with these in mind. Complete diagnostic x-ray studies of the thorax, the abdomen and the long bones are made in all cases but those of least malignancy. Doctor Hocker conducts a complete general physical examination. He consults with the urologist in charge. Using four portals for irradiation he points the tube pre-

cisely at the bladder. He estimates the presumed depth of the lesion. He "shoots" like a pistol, not like a shotgun. Such precision, such accuracy, we have reason to believe, is conspicuous by its absence in most x-ray laboratories. Precise report of the physical theory, of the technical details of treatment, will not be attempted here. These with the statistics of our results will be offered before the Radiological Society of North America next fall by Miss Quimby, physicist at the Memorial Hospital, and Doctor Ferguson, co-authors of this modification of roentgen therapy.

Until quite recently roentgen therapy has been applied to the "full erythema dose" method. The usual set-up is 200 k.v., 4 to 25 ma., 0.5 mm. copper and 1 mm. aluminum filter and skin-target distance 50 cm. Two to four treatments are given at four to seven days' intervals. Skin tolerance limits the treatment. Such treatment usually causes marked x-ray sickness characterized by nausea, vomiting and prostration; much damage to skin, little damage to tumor.

Coutard has shown that superior results may be expected if each dose of x-ray is reduced from 700 roentgens to 300 or 400 roentgens, exposures to the x-ray being repeated daily for eighteen or twenty days. By Coutard's therapy the surface effect is less, the deep effect greater. Thus x-ray sickness is less, but (in the pelvis) irritation of the bladder and of the bowel is considerable.

Various authors have corroborated Coutard's findings. Ferguson, in observing the effects of Coutard therapy on teratoma of the testicle,* reports as follows:

"In a series of 154 patients treated before 1928 by the old full erythema dose technic, the three-year survival was 35 per cent. In a similar group of fifty-nine patients treated by the divided dose technic, the three-year survival was 52 per cent. The most important observation, however, was that the increase was almost wholly confined to the more radioresistant types of teratoma. The increase in the tube distance from the skin results in the delivery of an increased percentage of dose to a depth of 10 cm. The increased filtration protects the normal structures from damage, and the recovery of these structures from the influence of the rays is at a greater rate than the recovery of the tumor. These points have been established by study of the biologic effects upon the separate tissues involved. The continuous delivery of small daily doses results in a cumulative

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lethal effect on tumor at a depth of 10 cm. which far exceeds in rate the effect on skin and other normal structures. Hence, it is now possible to deliver to radioresistant tumors of low grade, whose tissues are only slightly more radiosensitive than the normal epithelial structures from which they are derived, a dose calculated to result in the disappearance of the tumor. An added advantage of external irradiation by this technic over the use of interstitial radon irradiation is that the dose is diffusely and uniformly applied to the entire tumor and avoids the errors incident to the placement of gold seeds."

Doctor Ferguson, having conferred with Miss Quimby as to the details for administering the maximum dose of ray to a radioresistant tumor at a depth of 10 cm., determined upon the following set-up: 200 k.v., 25 ma.; filtration 1.7 mm. of copper, 1 mm. of aluminum; skin-target distance 100 cm. Four portals are employed, one over each rectus, one over each buttock, to be irradiated in pairs each alternate day. Duration of irradiation fifteen and one-half minutes, whereby a dose of 100 roentgens is delivered to each portal. Total dose, 3,000 roentgens to each portal, more or less. By this method 15 to 20 per cent increase in dose of effective radiation at a depth of 10 cm. is obtained. The treatment is continued for forty-five to sixty days.

The results of this method of treatment have been (1) absence of x-ray sickness, (2) relief of bladder spasms as far as they are due to tumor, (3) checking of hematuria in the second or third week, (4) minimization of skin irritation (defluvium and pigmentation occur but not desquamation). The bladder irritation is mild. If the patient is passing urine about every hour, this irritation does not increase. If at the beginning of treatment micturition intervals are normal, an increase in frequency up to once an hour, lasting for a few weeks after treatment, may be looked for. Constipation is relieved or a mild diarrhea set up for a like period.

This therapy has been applied by Doctor Hocker to tumors in various parts of the body with comparable results. If cystoscopy is performed within a month after treatment, the mucosa will sometimes appear inflamed, sometimes normal. We have vainly endeavored to follow at two weekly intervals during treatment the destruction of tumor. One day the tumors are there showing some cellular disintegration, the next day they are gone. In Case 1, the last tumor did not drop off until after four months (but the

patient was treated by the Coutard method). Usually the last tumor disappears within six weeks of the conclusion of treatment.

The therapy has been applied to all types of epithelial bladder tumors. We have not as yet established any variation in efficiency. The one tumor that has relapsed was of grade I malignancy. We believe (not unnaturally) that it was insufficiently treated. One patient whose bladder was irradiated by various methods has been overtreated. The tumors are gone but seemingly normal mucosa bleeds spontaneously from time to time in an alarming manner. This case will be reported to date before the American Medical Association.

Beginning with Case 1, in June, 1934, we find that we have treated thirty bladder tumors by irradiation in divided doses. Various modifications of Coutard's technic were employed until January 8, 1935. Since then we have employed our own technic, as above described, in twelve cases. Among the twelve we note one relapse, no deaths, four cases in which subsequent cystoscopy reveals no tumor, and eight patients doing well but still under treatment. Among the total thirty cases we find four patients have died, one is not relieved, one has a recurrence and sixteen have been relieved of their symptoms and cystoscopy has shown no tumor. It is manifestly too soon to gnash our teeth over statistics.

Case 1.—(Treated by Coutard therapy). Sister C. G., aged fifty-two. In December, 1928, we performed suprapubic cystotomy, scooped the masses of soft papillary tumor out of the bladder and found that the bases of these grew in a line transversely across the fundus and up the right side of the bladder. Ten 1 mc. radons were implanted.

Tumors in vault were fulgurated in March and April, 1929. Incrusted tumor at the bladder neck and another near the left ureter were fulgurated in November. The bladder neck tumor was again fulgurated in March, 1930. Specimen from this was reported grade II. (Registry No. 177.) Cystoscopy in June indicated no tumor. Four tumors were found in the vault in September. Fulguration and cystoscopic implantation of radium failed to control these so the bladder was resected in January, 1933. Specimen reported grade II plus, or III. In June cystoscopy showed no tumor. A year later cystoscopy revealed twelve tumors in the vault and two in the base of the bladder. Coutard treatment was begun in August, 1934. Sixteen treatments through four portals were given. Cystoscopy in November showed no tumor. The patient remains well.

X-ray therapy counts for much in the treatment of such a case. Without this we should have been at a loss to know what to do next. Our other cases since that time have shown various degrees of malignancy. Case 2 is an example of the kind of case in which, at the moment, we take the greatest interest. It is similar to Case 1, excepting that the tumor is graded between I and II, and the treatment had been given by our latest method.

Case 2.—C. R., sixty-nine years old, was first seen in December, 1930. He had a prostatectomy six years before by Legueu. His first hemorrhage had been one year before consulting us. The bladder was opened suprapubically and nine 1.5 mc. radons were implanted into the tumor near the right ureter, the base of which was 3 cm. in diameter. A month later the tumor was gone. In April, 1932, there was a recurrence of tumor in the same site. This was destroyed by fulguration in Bogota. Another recurrence, in 1933, was destroyed by fulguration. In February, 1935, a number of tumors were seen, in Bogota. He came to us and began x-ray therapy in April. Cystoscopy six weeks after conclusion of treatment showed all tumors gone. A granulating spot back of the right ureter marks the site of a tumor.

SUMMARY

We are aware that this report is quite informal, but venture to put it before you as suggesting a modified form of x-ray, founded upon the principles enunciated by Coutard yet offering the patient (1) a greater comfort during and after treatment, and (2) greater prospect of relief for tumors of low malignancy regardless of their distribution. By the Coutard and later by this modified treatment we have irradiated many malignant tumors. Since treating the patient in Case 1 a year ago, we have irradiated thirty patients. Sixteen of these have been relieved of their bladder tumors.

DISCUSSION

Dr. J. Dellinger Barney (Boston, Mass.): I should like to pay tribute to Dr. Keyes' very illuminating description of his x-ray method of treating these multiple bladder tumors. We all agree that they offer one of the most discouraging conditions that we have to see. From what he says there ought to be a great deal of hope in this method. We have all struggled with bladder tumors. In many cases where it was possible we have burned them off through a cystoscope, planted a seed or two of radium in the bases, cleaned them up, and then had them recur in a few months perhaps in a different place, and we have kept at that process ad infinitum. In some patients, of course, where the tumor was out of reach and more or less out of view, that method couldn't be used and it was necessary in many cases to do a total resection of the bladder.

After observing one or two of these cases where the crop of tumors cleared away and where they recurred at a later time, it seemed to me that it was a sort of state of mind of the bladder. That is the best way I can express it. Not long ago, there came to me a woman of about sixty, for whom I had burned off two or three of these bladder tumors and put in a seed or two of radium, and cured her, or thought I did, for seven years. She came in from time to time with nothing to be seen. Finally at the end of the seventh year she came in with no symptoms at all, and to my surprise there were three more tumors in a different part of the bladder. What brought it about we don't know, but I speak of the state of mind of the bladder as being a moderate explanation of the thing. I think Dr. Keyes' method may offer great hope in such cases.

Dr. Benjamin S. Barringer (New York City): I believe that Dr. Keyes and Dr. Ferguson have made an important contribution to the therapy of bladder tumors.

Several thoughts have come into my mind about external irradiation. In the first place if the papillomas, so-called grade 1 carcinomas, are separated from the real carcinomas and are taken alone, it is my impression that we are using an unnecessarily

severe prolonged therapy to control them. Dr. Beer and Dr. Keyes almost simultaneously popularized the method of fulguration of bladder tumors and I believe that still stands.

On the other hand the carcinomas, the grade 2, 3 or 4, present a different situation. We have tried by the Coutard method, by the 700 volt machine and by the 200 volt machine, treatment of these bladder tumors, by external irradiation alone. Dr. Dean has one case in which a very extensive infiltrating carcinoma, proved by pathology (I think it was grade 3), was entirely cleared up. We have used this method in countless other cases and have not been so successful. My impression is that in but 15 to 25 per cent of real bladder tumors is external irradiation enough.

We have been able to get a little more irradiation with the 700 volt machine than we could with the 200 volt machine, not much more, but a little more; not as much as 200 and 700 would indicate. We have never been able to control very many of these tumors. I think external irradiation goes through the whole tumor cycle all over the body. This is true in uterine tumors. The only tumor to which this statement does not apply is the embryonal teratoma of the testes. That can often be controlled by external irradiation alone. I think therapy by radium (if you use irradiation therapy) in the bladder tumor must be used in addition to the external irradiation.

I am inclined to think that possibly Dr. Keyes is a little too optimistic concerning the treatment of these tumors by external irradiation alone. Most of them require from six to seven erythema doses, and by external irradiation you can get at the most only three or four.

Dr. Henry G. Bugbee (New York City): I should like to cite a case bearing upon Dr. Keyes' paper. The patient is a man who was first seen in August, 1920. At that time he was forty-six years of age. He had profuse hematuria, and cystoscopic examination showed multiple papillomata of the bladder. Some of these papillomata were discrete; while in certain areas there were plaques of mucous membrane, elevated and papillomatous on the surface, but devoid of definite papillomata. He was treated by fulguration for a number of years. The condition was held under fair control until 1926, when the patient had a very

profuse hemorrhage. At this time I opened his bladder and by electric cautery burned out all the papillomata that I could find. Sections of growth showed a grade 2 papillary carcinoma.

Following operation this patient had many recurrences and I continued to treat him by fulguration until last August, when the condition got beyond control; many papillomata and several large plaques again appeared. We then started deep x-ray therapy under the guidance of Dr. Francis Carter Wood and during the past three months his bladder has been almost entirely free of growth. I have no doubt that he will have recurrences, but it does seem to me that the deep x-ray therapy aided us in obtaining a control which we had not succeeded in acquiring by any other means.

DR. NATHANIEL G. ALCOCK (Iowa City, Iowa): I should like to say a few words about Dr. Keyes' paper, simply to add emphasis by repetition. For the past two years we have been doing the same thing and using just about the same technic. In talking to him yesterday I told him that if the results that I have seen had not happened right under my eyes I would not have believed them. In a few of the cases the changes have been almost unbelievable.

Another thing that has impressed me in relation to recent x-ray therapy is lack of reaction on the part of the patient. The general reaction seems to be only very slight or entirely absent and there is not the skin reaction we used to see.

I am convinced that recent x-ray therapy is a distinct advance for treatment of bladder tumor. I agree with Dr. Barringer when he says that it is not enough. We never have had enough to make the treatment entirely satisfactory, but x-ray therapy as now administered is a distinct addition to what we have had in the past and certainly is quite encouraging for the future. We cannot gauge what x-ray treatment will do today by what it did five years ago. Past results must be entirely discarded. The present results do give us some hope of what x-ray therapy is going to be ten to fifteen years in the future.

We are using x-ray therapy routinely for all bladder tumors, but we are not using radium. We also use it routinely on all carcinomas of the prostate with the same surprising results in

some of the cases. The percentage of these cases that show results is surprisingly large. We do not use it in any of the cases where there is metastasis except with the idea of helping to control pain.

DR. T. M. DAVIS (Greenville, S. C.): I wish to discuss Dr. Keyes' paper and to report what I have been doing with bladder tumors. A patient in 1925 had a bladder tumor that was fulgurated at the Mayo Clinic. He returned to the Crowell Clinic in 1930 with multiple papilloma in the bladder. Cystotomy was performed and the tumors were destroyed with coagulating current. The tissue examination showed papillary carcinoma. When I became associated with the Crowell Clinic in 1931 I inherited this case. The patient had extensive recurrence in the bladder scar and multiple papillomata scattered over the bladder. I coagulated these tumors every four weeks. There would be many small papillomas, from ten to twenty, at every seance. The tumor in the scar was destroyed, but the numerous new tumors were very discouraging to both the patient and the operator. Radium was employed without any appreciable effect in controlling the recurrences. The patient was given x-ray therapy in sufficient dosage to cause a blanching of the bladder mucosa. After this treatment the bladder remained tumor-free until about two months ago, when he had one small recurrence which was fulgurated. X-ray treatment was repeated.

I have had seventeen patients with bladder tumors since 1931. They have responded very nicely to removal of the tumor with the resectoscope, fulguration and x-ray therapy.

The results that I have obtained with x-ray and resecting with the resectoscope and fulguration have been better than those with radium.

The technic which has been outlined by Dr. Keyes is very interesting and I will give it a trial. However, I have been insisting that my patients receive sufficient dosage to blanch the bladder mucosa and have not observed any fibrosis in the bladder walls other than would be expected at the site of a large infiltration.

I have also been very gratified with my results in employing x-ray treatment in prostate carcinoma following resection.

SCHISTOSOMIASIS INVOLVEMENT OF THE UPPER URINARY TRACT

REPORT OF PATIENT WITH PAPILLOMATA OF RENAL PELVIS, URETER, AND LATER OF BLADDER

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The case report forming the raison d'être of this presentation is not merely another of the relatively few instances of schistosomiasis reported in the United States, but is one of the rare examples of renal involvement and, in fact, is apparently unique in that the lesion is a papillary growth of the pelvis and calices, which in this case seems to have been the primary involvement of the urinary tract.

There are three trematode worms of the genus schistosomum which infest the human body,[1] while others are described pathologic to lower animals only.[2,5] (A) The *Schistosomum mansoni,* found especially in the West Indies and South America, has ova characterized by a lateral spine and attacks ultimately and particularly the intestinal tract. The diagnosis is made by finding the ova in stools. (B) The *Schistosomum japonicum,* found chiefly in Japan and neighboring countries, attacks the liver, causing first enlargement then atrophic cirrhosis, and produces necrosis and erosions of the intestines; there may be enormous enlargement of the spleen due to portal stasis, brain inovlvement, et cetera, but the urinary tract is quite immune. The ova are lacking a spine, or at most have but a slight protuberance. (C) The *Schistosomum hematobium* is the parasite of chief interest to urologists inasmuch as involvement of the urinary tract is the outstanding lesion. Indeed, in certain places in Africa, this infestation commonly called bilharziosis "dominates the whole of genito-urinary surgery" (Madden). It is encountered especially in Northern Africa, and also in India, Mesopotamia, Madagascar, Greece and Japan. The ova have terminal spines, which are diagnostically characteristic, and are found most frequently in the urine and in histologic slides made from the tissues involved.

The life history of the three species is practically the same.

The parasites are found in certain veins of man, the slender female being partly held in a canal formed on the surface of the broader male. The Schistosomum hematobium worms are found especially in the portal, hemorrhoidal and vesical veins. They make their way to the smaller veins, where the ova are extruded and finally enter the neighboring tissues (particularly the bladder) and many ultimately reach the urinary passages. If the ova reach fresh water they develop quickly into "miracidium" which move freely but die within forty-eight hours unless they find snails of certain varieties. Within the snail a sporocyst is formed in the liver and from this embryos (cercariæ) emerge. These also swim freely in fresh water and may infest man, entering through the mucosa or skin. They are carried to the portal system where they develop and mate.

None of the snails which have been proven to act as the obligate intermediate host is found in the United States, hence all patients presenting any one of the three species of schistosomum infesting man must have become infested in another country. However, this may have occurred years before a given patient has come under observation, for there are recorded many individuals who have passed viable ova eighteen years (and at least one, twenty-eight years) after infestation.[3]

Culver and Hoeppner[4] could find but twenty-five reported instances of vesical bilharziosis in this country in 1929, and found no record of such a patient observed in the vicinity of Chicago prior to their report of one. In reviewing schistosomiasis as diagnosed at Bellevue Hospital (New York City), I have found but one record other than that recorded here of Schistosomum hematobium infestation—in 1913; characteristic ova were found in the urine and in granulation tissue removed from the bladder of a man born in Syria and resident in New York only six months. From 1927 to 1934, there were five patients who had come from Porto Rico, who presented ova of Schistosomum mansoni in the stools.

This paucity of such cases in this country is in marked contrast to conditions in certain parts of Egypt where schistosomiasis has been a serious local scourge for centuries.

Ruffer[16] demonstrated calcified ova of Schistosomum hematobium in mummies of the 20th dynasty (1250-1000 B.C.). At the

Kasr-el-Ainy Hospital of Cairo more than 10 per cent of surgical admissions, recently observed during a three-year period, were due to Schistosomum hematobium,[1] while Ferguson reported that over 50 per cent of autopsies showed evidences in the urinary tract of the same infestation.

The diagnosis may be suggested by eosinophilia. Byam and Archibald[1] state that it may be 13.5 per cent when the patients are seen within three years of the infestation, while the earlier cases may show an eosinophilia over 50 per cent. More recent work[5,6] points to a successful complement fixation test, using an extract of cercariæ obtained from snails as an antigen. Reference is also made to a skin test. Cystoscopic pictures may be suggestive but are not characteristic. But the most convincing proof of diagnosis is the presence of typical ova in urine or tissues; they have been found also in semen and hydrocele fluid. From fresh ova, miracidia may be hatched if the former are placed in fresh water heated to 120°.

Treatment for advanced lesions such as tumor formation is usually surgical. However, the fundamental cure is obtained from drugs. Intravenous injection of antimony tartrate has been most widely employed. Emetine, papaverine, fuadin, emetine periodide, antimony sodium thioglycolate, antimony thioglycollamide and carbon tetrachloride have been successfully used, according to the literature of the past decade. The possibility of thorough eradication of bilharziasis from an endemic area has been well proven by Khalil,[11] who found that five parts of copper sulphate added to a million parts of water would kill all the types of snails capable of serving as intermediate host.

Although the urinary tract, especially the bladder, is the commonest site of diagnosed lesions, the Schistosomum hematobium may also cause nodules within the epididymis and along the spermatic cords, cysts of the prostate, and lesions of the seminal vesicles, corpora cavernosa and spongiosum, the urethra, the female genitalia,[7] and also in many other organs of the body.

The various evidences of schistosomiasis found in the bladder, including papillary tumors (benign and malignant) and calculi, have been repeatedly described. Our chief interest at this time, however, concerns the less frequent involvement of the ureter and

the rare findings in the kidney. Practically, as is repeatedly emphasized, the most important phase of upper urinary tract complicity is that dependent upon obstruction—hydronephrosis, infection and atrophy. Local implantation of ova in the ureter with ensuing tissue reaction has been described and case reports are easily found, but similar lesions of the kidney are indeed rare. Many authors state that they occur, but few specific reports have been found. Byam and Archibald describe the same inflammatory infiltration about ova, with abscesses and papillomata, in the ureter as are found in the bladder; also, in the lower ureter, there are sometimes seen small cysts with clear or turbid contents. Urquhart[19] described six such specimens found at autopsy with good illustrations of microscopic appearances which suggest the formation of cysts from invaginated pockets of epithelium. Sorour[17] described one case of bilharzia cancer of the ureter in 1929, and in a statistical article[18] the following year he cited eighty cases of cancer of the bladder among 413 patients with bilharzia, four of sarcoma of the bladder, four of endothelioma of the peritoneum, four of cancer of the rectum, one cancer of the cecum and one epithelioma of the skin; but referred to no such tumors of either ureter or kidney. Knipfer[12] reported a case of bilharzia disease with a tubular infiltration of the upper ureter, found by x-ray. Lowenthal and Roberts[13] recently recorded an instance of bilharziosis affecting the ureter primarily; there was an inflammatory lesion surrounding ova, but no papilloma.

Isolated foci in the renal parenchyma are rare, but do sometimes occur in heavily infested patients. In examinations of Egyptian mummies, there were two showing calcified ova in the kidneys. Ova were found in renal parenchyma at autopsy by Kartulis[10] in 1885. Glaesel,[9] in 1909, cited a case of Goebel, in which there were bilharzia ova in the kidney pelvis with simultaneous hydronephrosis and ureteral bilharziosis. Pugh,[15] in 1925, described a fistula which had discharged pus and urine for six months following incision for supposed perirenal abscess. Ova were found in urine obtained from both the fistula and the bladder. The sinus healed in four and one-half weeks after initiating treatment with tartar emetic.

Thus it is clear that specific attack by the ova of Schistosomum

hematobium is common in the bladder, less frequent in the lower ureter, only occasionally noted in the upper ureter, and is decidedly rare in the kidney. Definite case reports of the latter are few, although all books on tropical medicine refer in a general way to occasional renal involvement. Thus far I have been unable to locate any record of papilloma of the renal pelvis or calices due to schistosomiasis, other than the one following. Similar growths in the bladder are supposed to be primarily proliferation of connective tissue with consecutive epithelial proliferation. Goebel[9] made a detailed study of forty-eight bladder growths, from which he drew interesting conclusions, which are probably equally applicable to tumors of the same genesis found in the renal pelvis.

CASE REPORT

P. P., male, aged thirty-six years, decorator by occupation, entered the medical wards of Bellevue Hospital, November 17, 1932, with abdominal pain. The patient was born in Greece, where he lived until seven years old. The next seven years he was in Alexandria, Egypt; then followed seven years in Syria, two in Greece, five in the United States, two in Central America and Cuba, and since 1929 he has lived in New York City. The patient contracted gonorrhea in 1917 and syphilis in 1925. Hematuria was first noted about 1923; this recurred at first about every six months, then at briefer intervals, and latterly every week or two. Pain in the left back and left chest appeared about 1925, and in 1929 there was noticed a mass in the left abdomen. Pain radiated from the back around both sides to the abdomen. Occasionally blood was noted in the stools. The Wassermann test findings were reported negative; chest and abdominal examinations revealed nothing abnormal except a mass in the left abdomen. Cystoscopy and ureteral catheterization proved good function of the right kidney, but no urine came from the left ureteral catheter. Pyelograms showed a fairly normal condition of the right kidney, but only a large diffuse shadow on the left side. In the left abdomen was felt a large mass with soft, cystic bosses over the surface, not tender, and movable on palpation and with respiration. A diagnosis of hydronephrosis was made. The patient declined operation and left the hospital.

On April 24, 1933, the patient was admitted to the urologic service, with increased pain in the left abdomen and lumbar region. He had lost 10 pounds. The mass extended from under the left costal margin to just above Poupart's ligament. The liver and right kidney were not palpable. There were superficial dilated veins on the abdominal wall. The urine showed plus albumin, some red blood cells,

but no pus. The red blood cell count was 4,520,000; hemoglobin 70 per cent; leukocytes 15,200; with differential count of 84 per cent polymorphonuclears but no eosinophiles. The non-protein nitrogen and creatinin of the blood were normal on several occasions. The phenolsulphonephthalein output varied from 20 and 15 per cent to 35 and 15 per cent for two hours. Wassermann test findings were again negative. Cystoscopy confirmed the earlier findings. The catheter would pass only 20 cm. up the left ureter and no urine was obtained.

Operation was performed May 2, 1933. The large left kidney (25 cm. in length from pole to pole) and 3 inches of ureter were

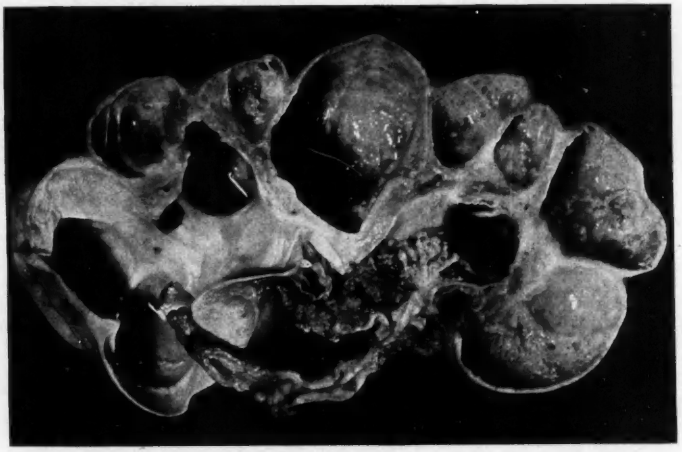

Fig. 1. Hydronephrotic kidney, 25 cm. in length, with multiple papillary growths of the pelvis and dilated calices.

removed intact, extraperitoneally. Several glands, over 2 cm. in longest diameter, were felt near the hilum, and one was removed for examination. After the wound was closed (with drainage), the ureter was split open and a pedunculated papilloma, over 1 cm. in diameter, was found about 4 cm. from the pelvis. The latter was largely occupied by a papillomatous growth. Later the kidney was sectioned (Fig. 1), and similar growths were found widely scattered over the walls of the hydronephrotic sac. The pathologic diagnosis was papillary epithelioma of the kidney pelvis, but the gland showed only lymphoid hyperplasia with no evidence of metastasis. Convalescence was uneventful. Removal of the rest of the left ureter was advised but declined at this time.

The patient appeared at the clinic occasionally, but continually deferred the proposed operation. Four months after operation he complained of right abdominal pains, but nothing abnormal could be palpated. Finally, because of recurrent hematuria, he re-entered the hospital on February 8, 1935. Whereas cystoscopy a year earlier had disclosed a normal bladder, there were now found a small group of papillomata on the anterior wall, a small tumor on the anterior prostatic border, and another papilloma at the left ureteral orifice. A right pyelogram disclosed some clubbing of the terminal calices (as at the first examinations) but no satisfactory explanation of the pains complained of. Radiographs showed no metastases to bones or lungs.

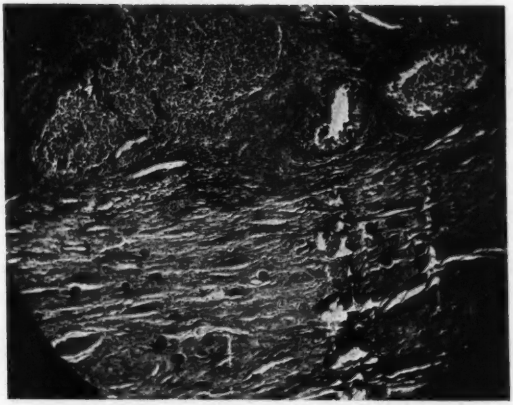

Fig. 2. Photomicrograph of ureter showing papilloma of the lumen, with numerous ova; the dense black ones are calcified.

At operation on February 15, 1935, the remaining part of the left ureter was removed with the adjacent bladder wall, and a portion of the bladder containing the group of small papillomata was resected. The growth on the prostatic border was destroyed by cautery.

Histologic examination of the tumors of the ureter (Fig. 2) and bladder showed the same picture—a papillary growth, in association with which were numerous ova, some of which presented a terminal spine. A restudy of the kidney tumors was then made, and in one section a definite ovum was found. Following this discovery many urine examinations were made but no ova were seen; members of the pathologic and medical staffs, as well as our own internes, searched in vain.

During convalescence, x-ray investigation of the gall bladder, stomach and intestinal tract failed to reveal any abnormality to ex-

plain the right-sided pain which persisted. Abdominal examination also persistently revealed no abnormalities.

Recovery was uneventful. During the latter part of his stay in hospital the patient was given a course of deep x-ray therapy to the left renal area, also intravenous injections of tartar emetic twice a week, 1.5 grains per dose. This was continued until 30 grains in all had been given.

Discussion.—The diagnosis of infestation with Schistosomum hematobium is clear, from the presence of numerous, typical ova with terminal spines in the papillomatous tissues removed from the bladder and ureter. The few ova in the kidney tumor were easily overlooked at the first examination. We were fortunate in the opportunity for repeated cystoscopies, and know that the bladder presented no visual evidence of the disease a year before the last operation. It is astonishing that no ova could be demonstrated in the urine although many were present in the bladder wall. The lesions of the renal pelvis were advanced and must have existed for years, and it seems fair to conclude that, contrary to the usual rule, these were the primary ones in the urinary tract; also, that the recent appearance of papillary growths containing numerous ova, on the bladder wall, indicates that the patient was still harboring the live worms. It is hoped that the attempt to destroy the latter with tartar emetic will eliminate the abdominal pain complained of the past year.

BIBLIOGRAPHY

1. Byam and Archibald: The Practice of Medicine in the Tropics. Vol. III, London, 1923.
2. Castellani and Chalmers: Manual of Tropical Medicine. New York, 3rd Ed., pp. 584-593, 1920.
3. Christophersen, J. B.: Longevity of parasitic worms, etc. Lancet, 1:742, 1924.
4. Culver, H., and Hoeppner, W. F.: Vesical bilharziasis. Jour. Urol., 27:189-200, (February) 1932.
5. Fairley, Mackie, Jasudasan: Studies in schistosomiasis spindale. Indian Medical Research Memoirs, 1930.
6. Fairley, N. H.: Vesical schistosomiasis complicated by carcinoma. Brit. Med. Jour., 2:983-985, 1931.
7. Gibson, R. W. B.: Bilharziasis of female genital tract. Med. Jour. So. Africa, 21:44-45, (September) 1925.
8. Glaesel, P. F.: Contribution à l'étude de la Bilharziose. Paris Thesis, 1909.
9. Goebel, Carl: Ueber die bei Bilharzia—Krankheit Vorkommenden Blasentumoren mit besonderer Beruecksichtigung des Carcinoms. Breslau, 1905.

10. KARTULIS, S.: Virch. Arch., 99:139-145, 1885.
11. KHALIL, M.: Eradication of bilharziasis, etc. Lancet, 2:1235, (Dec. 10) 1927.
12. KNIPFER, A.: Radiolog. Med., 14:1071-1076, 1927.
13. LOWENTHAL, H. F., and ROBERTS, R. A.: Bilharzia affecting left ureter primarily. Lancet, 2:706-707, (Sept. 29) 1934.
14. PFISTER, E.: Bilharziasis of scrotum. Ztschrift, f. Urolog. 16:16-18, 1922.
15. PUGH, W. S.: Schistosoma hematobium infection and its relation to persistent urinary sinus. N. Y. State Jour. of Med., 25:643-645, (April 17) 1925.
16. RUFFER: British Med. Jour., 1:16, 1910.
17. SOROUR, M. F.: Benign and malignant tumors produced by irritation of bilharziasis. Ann. de Parasitol, 7:381-398, (Sept. 1) 1929.
18. SOROUR, M. F.: Ann. de Paratollogie, 8:610-614, 1930.
19. URQUHART, A. L.: Cyst formation in the ureter, associated with bilharziasis. Brit. Jour. Urol., 3:21-25, (March) 1931.

DISCUSSION

DR. B. H. HAGER (Los Angeles, Calif.): I can't pass up an opportunity of saying something about schistosomiasis, as tropical diseases and parasitology have been a hobby of mine since I was at the U. S. Naval Medical School. Dr. Stevens' title misled me; otherwise I would have brought with me some interesting slides portraying the alternation of generation which takes place in the development of this parasite. Schistosomiasis is a general term which implies an infection with any of the blood flukes or trematodes, of which there are three species that are pathogenic for man, namely the Schistosoma japonicum, Schistosoma mansoni, and Schistosoma hematobium. They differ primarily in their geographic distribution, in their selective localization within the human host, in their requirement of a specific mollusk for their intermediary metamorphosis and in their respective ova. The Schistosoma japonicum is an oriental disease, confined rather sharply to Japan and China. It is characterized by lung and liver symptoms. The bladder never becomes involved, so it is of no moment to the urologist.

Schistosoma mansoni and Schistosoma hematobium are both common to Africa, where the disease is rampant in many sections. Only one species, the Schistosoma mansoni, exists in the western hemisphere. It can be regarded as our heritage from slavery and has remained limited to the West Indies and certain localities in South America where conditions favorable for the completion of its life cycle obtain. The presence of the necessary intermediary host, therefore, limits the geographic distribution of the disease. Man is the only definitive host in which maturation of the worm takes place. While certain laboratory animals have been infected experimentally, there is no evidence to show that they become infected in their natural state. The Schistosoma mansoni has a predilection for the rectum and is characterized by rectal lesions, hence its name rectal schistosomiasis. In Africa, where both forms of schistosoma are prevalent, a double infection may occur in which Schistosoma mansoni infection occurs in the bladder as well as in the rectum. In the West Indies, where the Schistosoma mansoni infection alone exists, the bladder does not become involved.

Vesical schistosomiasis or bilharziasis is characterized by lesions of the urogenital tract, usually of the bladder. There are two features in the diagnosis which I should like particularly to emphasize. The first is the use of an extract of cercariæ as a skin test. This has been successfully used by the school of tropical medicine of the University of Porto Rico and appears to be a valuable diagnostic aid. The second is the value of the x-ray in the recognition of vesical schistosomiasis. Myriads of ova are expelled into the bladder lumen and passed with the urine. However, not all of them are extruded into the bladder, many of them becoming arrested in the submucosa, where they undergo calcification. The calcified ova in the tissue cast a very characteristic shadow on the x-ray plate which is pathognomonic of bilharziasis. In bladders in which the process has gone on quite extensively there is a vague opacity that more or less outlines the periphery of the bladder which I might liken to the shadow cast by a fetal head. Where the calcification in the lower ureter is marked, a mottled shadow of the dilated ureter can be demonstrated. Intravenous urography is particularly useful in the demonstration of the obstructive uropathies because of the difficulty of instrumentation incident to the distortion and fistula formation in the urethra.

As Dr. Stevens has mentioned, tartar emetic is a specific for the disease. It kills the parasite and it also destroys the eggs which have been deposited in the tissue. Christopherson, who introduced tartar emetic, suggests a course of 30 grains given intravenously over a period of twenty-eight to thirty days.

Dr. A. R. Stevens (New York City): I appreciate Dr. Hager's discussion of my paper. I hurried over certain parts of it to finish within the time and I didn't go into the use of x-ray. There is one very interesting report of a diagnosis based chiefly on the x-ray, showing a circular shadow along the course of the upper ureter.

Although most articles and books on tropical medicine always speak of the involvement of the upper urinary tract, it is the dilatation that comes from obstruction lower down to which reference is most often made. This obstruction is often due to contraction of scar tissue that is in this reactionary tissue, and is sometimes due to the actual presence of a papilloma, as was true in my patient.

OBSTRUCTIONS AT THE BLADDER NECK IN INFANTS AND CHILDREN

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The mastery of the urinary tract in infants and children has been the most outstanding and gratifying accomplishment which modern urology has attained.

The development and perfection of instruments of small caliber, the striking tolerance of infants and children to instrumentation when judiciously performed, and the coöperation of the pediatrician in seeking special investigation of the urinary organs in children, creates a trinity designed to exert a tremendous influence in the development of infantile and juvenile urology.

The sole function of the excretory ducts of the urinary tract is to deliver the accumulated urine without impediment. Unfortunately, obstructive conditions along the urinary pathways are exceedingly frequent and take as their points of predilection the normal physiologic constrictions:

1. The ureteropelvic juncture.
2. The intravesical ureter.
3. The internal orifice of the bladder (this the most frequent).

Stasis is a natural accompaniment of such obstructive conditions. The problem, therefore, resolves itself into one of hydrodynamics. These obstructive uropathies in infants contribute tremendously to infant mortality and should always be suspected in unexplainable cases of malnutrition, particularly if associated with urinary difficulties. Such suspicion may be confirmed by a determination of the nitrogenous constituents in the blood. If these are decidedly increased, a prompt urologic investigation should be undertaken and the cause, which is usually obstruction, should be removed at the earliest possible moment.

Bugbee and Wollstein found 117 congenital lesions of the urinary organs in infants in reviewing 4,903 necropsies performed at the Babies Hospital in New York. Fifty per cent of these were due to some form of congenital obstruction. Thus 1.2 per cent of all the infant mortality occurred as a result of obstruction either

with or without infection, the most frequent location being at the internal orifice of the bladder.

As a result of stasis, infection is to be expected and urinary infections in children are strikingly frequent. In the St. Louis Children's Hospital one in every forty children either had such infections upon admission or developed them during the course of their stay. The majority of these were acute, the so-called acute pyelitis, usually secondary to some focal lesion elsewhere, the most common of which were middle ear, nasopharyngeal, pulmonary, intestinal or vaginal. Many of these acute conditions are cured following the relief of focal infections and the administration of urinary antiseptics and copious flushings. Such relief usually requires from one to three weeks. Urology at the present time is not serving its proper function with this type of acute kidney infection. Prompt ureteral catheterization with evacuation of the pelvic contents, followed by topical applications, as is currently employed in the adult, should be administered to protect the kidney substance from the ravages of infection squeezed back through it from the overcrowded pelvis which is incapable of emptying itself. The inability of the pelvis to evacuate its contents properly is in most instances not due to a pre-existing stricture, but results from the acute inflammatory reaction with edema at the ureteropelvic junction secondary to the renal infection itself, a self-engendered obstruction. The longer the septic contents are allowed to remain permeating the delicate structural mechanism of the kidney, such a vital organ to human economy, the more likelihood of late scarring and irreparable damage with the formation of the framework of chronic lesions, chronic recurrent pyelitis and stone formation for years to come. In a personal communication with one of my confrères, Dr. Drennan, who is consultant at a reformatory for boys in the State of Illinois, I am informed that the presence of unsuspected pus and infection in the urine and of albuminuria and hypertension are exceedingly common, and in almost every instance there has been a preceding history of pyelitis in infancy.

Chronic infections of the kidney are the ones which the urologist usually observes and those which have resisted the orthodox medical administrations. Children with such infections are never in good health. They are either persistently toxic or are subjects of recurrent intermittent infections with febrile reactions. In both

instances some mechanical obstruction previously alluded to is usually the cause and must be investigated. The persistence of medical treatment to these chronic infections was formerly due to lack of familiarity with the causative factors and to the failure of urology in offering material aid. At present, however, the remarkable curative results obtained through conservative surgical measures predict a brighter future for such afflicted subjects.

The clinical picture resulting from obstructions in the different portions of the urinary system may be very similar and the general physical signs may appear misleading. For instance, a child may present a large tender kidney and the whole symptom-complex revolve around this one organ and yet the cause of this may be an obstruction in the lower urinary tract with both ureters and kidneys involved and only one manifesting the disease.

For practical purposes, and as an aid to the clinician, there are certain simple diagnostic procedures which may be helpful.

1. The determination of total renal function, by tests of elimination such as phenolsulphonephthalein or by tests of retention secured through a determination of the blood for its nitrogenous elements. If the total functional capacity is low, as indicated by these tests, one may be assured that both kidneys are involved regardless of the palpable evidences.

2. The determination of the presence or absence of residual urine. This is highly important. If residual urine is present, it is usually indicative that the condition results from obstruction at the internal orifice of the bladder and is in all probability bilateral.

3. The cystogram. This may afford valuable information in revealing the topographical outline of the urinary system. The fundamental lesion is at the bladder neck, if, upon filling the bladder, there is regurgitation up the ureters.

4. Intravenous urography. This may be serviceable in delineating the outline of the urinary system, but in my experience it has not been entirely reliable. I have seen it demonstrate normal pelves when pronounced hydronephrosis was present, and it is usually impossible to determine whether a dilatation of the ureter results from retention of excretion or regurgitation.

5. Cystoscopic investigation of the urinary tract. This is usually necessary before any definite plan of corrective therapy may be satisfactorily applied and it is indeed gratifying that children tol-

erate cystoscopic manipulation so admirably. Reactions are seldom observed. Indeed, they occur far less frequently than with the adult, if the child is properly prepared. The infant or child with high residual urine and uremia requires the same special preliminary catheter drainage as is commonly employed in the adult, before such procedures are undertaken. In hundreds of children whom I have examined, there has been but one serious reaction and this occurred many years ago in a child who was suffering from double chronic pyelitis without obstruction.

Anesthesia is required in only 35 per cent of the cases. If one is patient with these children, secures their confidence and allows the mother to be present with them during the examination there is seldom any difficulty in making a complete urologic investigation even in very young children, without general anesthesia. If general anesthesia is necessary it is applied for only a few moments during the instrumentation and should be removed as quickly as possible for functional studies and pyelographic determinations. The preponderance of girls over boys minimizes the necessity for general anesthesia, but even in very young boys such manipulations may frequently be consummated under local anesthesia.

Congenital valves and contractures at the ureteral orifice of the bladder are the most frequent causes of urinary obstruction in infants and children. I wish to report a series of twenty-six cases of such obstructions (Table I).

The importance of regurgitation of the vesical contents into the ureters and kidney pelves cannot be overestimated. It was present in these cases in 46 per cent. One-half of these occurred in the presence of a high residual urine, the remaining half with small residual urine. It is evident, therefore, that the presence of a high residual urine is not essential for the creation of such regurgitation. Stiffening and retraction of the ureterovesical valve resulting from infection is fundamental. I have observed in several patients ureteral valves with large regurgitant ureters that were incompetent before operation which after the relief of obstruction and subsidence of infection became competent and regurgitation did not occur.

TABLE I

AGE

	No. Cases
Under 2	5
2 to 5	9
5 to 10	8
Over 10	4

SEX

	No. Cases
Males	14
Females	12

SYMPTOMS AND PHYSICAL FINDINGS

	No. Cases	Per Cent
Frequency	13	50
Difficulty	8	
Incontinence	13	50
Pain and burning	7	
Hematuria	1	
Pyuria and pyelitis	18	69
Renal colic	3	
Uremia	8	30
Enlargement of kidney	6	
	(5 unilateral, 1 bilateral)	
Residual urine	21	80
over 100 c.c.	12	
over 500 c.c.	3	
no residual	2	
no note	3	

The lesions found at the vesical neck in this series of cases are recorded in Table II.

TABLE II

Contractures of the neck	9	(4 boys, 5 girls)
Valves	12	(6 boys, 6 girls)
Valve and lobule	1	(boy)
Valve and bar	1	(girl)
Villous mass and valve	1	(boy)
Lobules	2	(boys)

ASSOCIATED CONDITIONS

Relaxation of sphincter	6
Trabeculation	10
Diverticulum	3
Spina bifida	5
Calculus	1
Epispadias	1
Double ureter	3
Regurgitation	12
Bilateral	8
Right	2
Left	2
With residual urine over 200 c.c.	6
With small residual urine	6
With contracted neck	7
With valves	5

OPERATIONS

Operations were performed on sixteen of these children: fourteen cautery punches and two suprapubic. Six were for valves, one for valve and bar, seven for contractures of the vesical neck and two for lobules. The child's punch was used in nine instances and the baby punch in five. The remaining children were not operated upon, for three reasons: local treatment afforded relief, the parents refused operation, or the patient's general condition did not warrant surgery.

PRELIMINARY TREATMENT

All of these little patients who carried residual urine and who showed evidence of urosepsis were treated in a manner similar to the prostatic patient by preliminary indwelling catheter drainage, copious flushings and urinary antiseptics, oftentimes by the administration of subcutaneous saline and intravenous glucose injections and occasionally by transfusions until their condition appeared sufficiently satisfactory for any type of surgical operation. This type of preliminary treatment is just as important in children as it is to the prostatic patient. The operation is never performed until the nitrogen is normal, the febrile reaction has subsided and the general appearance of the child is good.

TECHNIC OF OPERATION

The punch with its obturator is passed into the bladder, which has been previously filled with sterile water or boric solution. In the infants, the baby punch, a No. 14 French size, is used and in larger children the child's punch, a No. 18 instrument, is employed. Following the introduction of the instrument the obturator is removed, and the instrument gradually withdrawn until the water ceases to flow. One is then assured that the vesical orifice is within the slot of the instrument. Previous cystoscopic examination has determined the exact nature of the obstruction and if it is a contracture of the neck the slot of the instrument is brought out in the midline below. The eye-piece of the instrument is lightly elevated, steadily securing the obstructing orifice within the slot, the tube is evacuated and dried with a cotton pledget, the orifice is visualized by reflected light and the working element carrying the cautery blade is passed through the sheath of the instrument until

it engages the obstruction, the heat is then turned on and by a rotary motion the obstructing band is punched out. The instrument is then removed unless further removal is deemed advisable. At times three bites are removed, seldom more. In case more bites are required, the instrument is re-inserted into the bladder, the water allowed to flow, the orifice grasped again lateral to the previous bite at 5 or 7 o'clock on the dial and the procedure repeated.

In cases of valves, which are always lateral, the instrument is inserted in the same manner, but the slot of the instrument is pressed toward the side from which the operator expects to remove a central section from the band, the eye-piece of the instrument passing in the opposite direction until one appreciates a hang and the water ceases to flow. The same process of removal is undertaken. Usually in the valve cases only two incisions are necessary, one on each lateral valve.

In none of these patients operated upon by the punch has there been the slightest bleeding. A small indwelling catheter is inserted for twenty-four hours. There has never been a postoperative hemorrhage, and in only one instance was there the slightest febrile reaction. These children have tolerated such operations much better than the adult. No complications have occurred. The operation is of course delicate and heavy pressure must not be exerted for fear of cutting too deeply. With light cauterization there is no danger of deep penetration of heat with the creation of slough beyond the field of operation. The high frequency current as a means of resection would be extremely dangerous in tissues so thin and delicate.

The after-care consists in accurate supervision, daily passing the catheter for vesical instillation of some mild germicidal solution and for the determination of the emptying ability of the bladder. If the bladder empties completely, all instrumental manipulation ceases. If some residual urine remains as a result of edema, catheterization and instillation continue until it entirely disappears. If within ten days the urinary function is not normal and residual urine is still present the child is re-examined and another operation performed. This has been necessary in only two instances.

The two suprapubic operations were performed a number of years ago, before the baby punch was perfected and would not have been necessary at the present day. Since these obstructive

conditions in children are either from contractures or valves it should seldom, if ever, be necessary to perform an open operation for their removal.

RESULTS

Thirteen of the operations have given perfect results. Two resulted in decided improvement but were not completely satisfactory. The parents refused to allow further surgical procedures. One case showed no improvement. This was a patient with pronounced spina bifida with a very thin, delicate valve. The removal of the valve gave no benefit.

The results following the removal of the obstruction through the urethra in children by means of the punch have been the most gratifying I have ever had in surgery. The end-results have been exceedingly satisfactory. Invalid children have been restored to excellent health by such a simple procedure with practically no complications or untoward effects and with no mortality. There have been several cases so striking in the series that they are worthy of special mention.

Case 1.—A boy, nine years of age, who had had a meningocele removed when a baby. The local result was excellent, but he had been incontinent all of his life and had worn a rubber urinal. Numerous urologists whom his family consulted in his behalf expressed the opinion that the bladder incontinence was due entirely to the nerve lesion. When I examined this child he had a typical neurogenic bladder, that is, a markedly relaxed internal sphincter which allowed visibility of the whole posterior urethra. There was a residual urine of 8 ounces. On close cystoscopic study I observed two small valvular folds running from the internal orifice of the bladder out to the region of the verumontanum. These were resected in their central portion by the baby punch. The child immediately began voiding a better stream and within a month had discarded the urinal. His urinary function was perfect and has remained so for the three years I have followed him.

Case 2.—A girl, six years old, with 300 c.c. residual urine, marked regurgitation and tortuosity of the ureters and dilatation of the renal pelves. I have watched this child for a number of years and observed in her a striking instance of the recoaptation of the ureterovesical valve. This child at present shows no regurgitation up the ureters after marked distention of the bladder. She had suffered with chronic pyelonephritis since infancy and is now entirely well except for a slight bacteriuria.

Case 3.—A girl of five, with 600 c.c. residual urine, tremendous dilatation of ureters and renal pelves, and marked uremia. She had suffered with and been treated for chronic pyelonephritis since infancy. She has been entirely well for three years following the removal of but one section of tissue from the midportion of a vesical neck contracture.

Case 4.—A boy, four and one-half years of age, who has been observed during the last year. He had suffered with pyelitis since infancy and had been treated constantly by qualified pediatricians. He was desperately uremic, carrying a nitrogen retention of 90. There was a dirty residual urine of 350 c.c. He required preliminary catheter drainage for three months. Cystoscopic examination showed, with only local anesthesia, a contracture of the vesical neck. Cystogram revealed a tremendous bladder, both ureters regurgitant, and over an inch in diameter. The renal pelves were very large. The roentgenogram of the completely filled bladder, ureters and kidneys practically covered the entire abdomen. Within twenty-four hours after the removal of the obstruction by means of the punch the child voided 8.5 ounces, whereas he had previously never voided over 2 ounces at a time. Within a month the urine was perfectly clear, and he was emptying his bladder completely. He has gained 6 pounds in weight and is entirely well.

Case 5.—A girl twenty-six months old, who had been a subject of recurrent febrile attacks for many months. Pus and bacilli had been found in the urine constantly, but there were no bladder symptoms. The child had been examined elsewhere, and a double ureter and renal pelvis were found on the right side with infection in the upper pelvis. Heminephrectomy had been advised. My examination revealed an obstruction at the orifice of the bladder due to valves, retaining 3 ounces of residual urine. The orifice of the ureter which drained the infected portion of the kidney was regurgitant. Following the removal of the valvular obstruction at the bladder neck with the baby punch, the residual urine disappeared and with it the infection in the kidney pelvis. This case shows the absolute necessity of observation of the nature of the ureteral orifice, determination of residual urine, and of the cystogram.

After relief of obstruction and free drainage afforded through normal bladder emptying, the ureters will usually empty themselves completely. In some instances repeated ureteral catheterizations are required in order topically to applicate the pelves and ureters and hasten resolution. I have never seen a patient who did not empty the bladder sufficiently in spite of the large tortuous ureters to insure relief of absorption. Peri-ureteritis with fixed

angulations seldom occurs in infants and children. With the proper relief of obstruction from below, absorption of peri-ureteral inflammatory reaction will usually result as the infection recedes. I see no indication for the extensive ureteral plastic operations such as freeing both ureters, straightening out angulations and resecting several inches of the duct, requiring anastomosis. This operation is extensive and serious and misses the point entirely. It is designed to treat the effect and not the cause and hence should have no place in this class of case.

I urge the profession to suspect such mechanical causes for the majority of persistent or recurrent cases of pyelitis in infants and children and to seek early investigation for such cases so that prompt corrective measures may be applied.

I can sincerely recommend the cautery punch operation for the removal of the obstructions at the bladder neck in infants and children. The procedure is delicate, but strikingly simple. It has been entirely free from complications such as hemorrhage and reactions. There has been no mortality and the results have been immediate, durable and most gratifying. It should entirely supplant any major surgical procedure.

THE PRESENTATION OF A NEW CAUTERY PUNCH

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My continued faith in the cautery current as the safest agent for the transurethral removal of prostatic obstruction as well as my firm conviction that greater security is afforded with the punch type instrument which anchors the obstruction within its slot have prompted me to simplify and perfect this instrument so that it may register a greater appeal.

The optical component of this instrument is similar to the previous one and of the same type as is employed in the various resection devices, namely, the McCarthy foroblique telescope, the only difference being that the operator observes the disc on the anterior part of the slot, a landmark which aids in accurately grasping the obstructing orifice. The protruding tissue is seen to roll in on the proximal side of this disc, assuring the operator that the desired tissue for removal is incarcerated. By exerting the usual punch grip there is absolutely no danger of injuring neighboring structures.

With the very valuable aid of Dr. Evan Kackley and Mr. Kenneth Drucker four novel improvements have been made: (1) A new lock, (2) a water seal, (3) a new blade, (4) a new handle.

The new lock is practically automatic and requires no special maneuvers to engage or disengage the parts. The light post of the previous instrument has been modified by adding a spring device which allows the working element, as it enters the sheath, to be locked automatically by simply pressing it home until a slight click is heard. At this point the blade is at the beginning of the slot and ready for operation. To disengage the lock one simply presses together the two finger grips provided on the working element and the working element is withdrawn without any change of position or without requiring the operator to visualize the motion. Once the working element is located within the sheath the blade may be pushed easily forward through the slot during the process of cautery cutting.

The new water seal is a special molded rubber external gasket

which is detachable and easily removed for sterilization or replacement. It fits over the rim at the entrance to the sheath of the instrument. This very simple and inexpensive device insures absolutely against even the slightest leakage.

The blade, made of selected 25 per cent iridium platinum, is curved slightly forward, allowing more uniform searing, easier cutting, and less tendency to bleeding. The new handle is attached near the entrance of the sheath. Its slight curve is made to fit the posterior part of the thumb, thus insuring a steady, firm grip.

Visualization with this instrument is perfect, since the irrigating

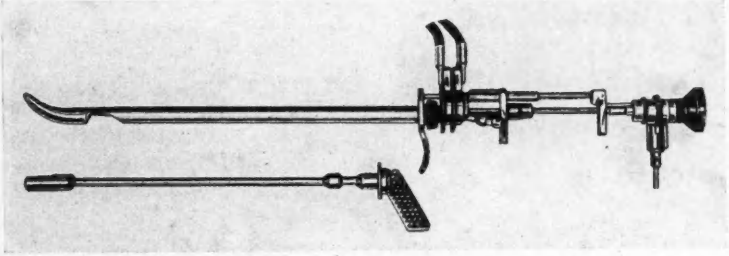

Fig. 1. Caulk-Kackley visual cautery prostatic punch.

channels are larger and allow copious flushings of the field of operation. This new instrument has so simplified the transurethral removal of the obstructing prostate in my hands that it is being employed to the exclusion of all other instruments. The pieces of tissue removed are larger, and as a rule one will average the removal of one piece of tissue per minute. The specimens average about 0.5 gram apiece so that within twenty minutes 10 grams of tissue can be easily extracted.

I have used this instrument steadily for six months with gratifying success without any complications, and not a single attachment to the instrument has required replacement.

DISCUSSION

DR. E. L. KEYES (New York): Dr. Caulk mentioned the fact that I had seen his work. I like his punch extremely well. This modern punch of his, the adult size, is larger than his old punch. It works nicely and it takes out larger specimens than I have seen removed by any other instrument.

I saw the red-headed boy who had the megalo-ureter and he looks like any other boy.

DR. LEON HERMAN (Philadelphia, Pa.): Will Dr. Caulk tell us whether cystometric readings are of any value?

DR. BENJAMIN S. BARRINGER (New York City): I had trouble in overcoming the retention of urine in carcinoma of the prostate in using the Caulk instrument with as short an opening as that in the instrument Dr. Caulk presents. So I very carefully took a file and made the opening a quarter or three-eighths of an inch longer and it seemed to work much better. It gets over these obstructions better.

DR. JOHN R. CAULK (St. Louis, Mo.): I have enlarged the slot on this instrument, but have feared to enlarge it too much because of making it so delicate that it would warp. One that we had enlarged about an eighth of an inch only bent, and so I was fearful of having an accident happen. At any rate, the slot seems large enough to allow the removal of a very large segment of tissue.

DR. BARRINGER (interposing): I had the same trouble and I had the mechanic put a thing across the top and it never did bend.

DR. CAULK: We have done no cystometrographic studies on these children. As far as the cystometrogram is concerned, it is very valuable in determining the tonicity of the bladder, but it is seldom necessary in such cases.

THIRD DAY, JUNE 8, 1935

CYST OF THE SEMINAL VESICLE

CLYDE LEROY DEMING, M.D.

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Cyst of the seminal vesicle sufficient in size to produce severe urinary or rectal symptoms has been reported seven times. The finding of small symptomless seminal vesicular cysts at autopsy is only occasional. This cyst is not to be confused with cyst of the prostate, vasa deferentia or hydrocele of the spermatic cord. Its rarity precludes its absence from the usual realm of diagnostic considerations for bladder diseases. So meager are the descriptions of the reports that the author wishes to give in detail the findings in a case successfully treated but incorrectly diagnosed until operation.

CASE REPORT (AUTHOR)

The patient, fifty-nine years of age, was admitted to the New Haven Hospital on August 8, 1933, complaining of burning and frequency of urination. The family history disclosed that his father and one brother had died of shock. There were eight siblings. He had married twice and had one child by his first wife. He always enjoyed good health and had experienced only childhood diseases in a mild form. There was no history of accidents or of operations. For the two preceding years, he had voided twice in the morning, twice in the afternoon and once at about 3 A. M. The present illness began suddenly on June 20, fifty days prior to admission. He first noticed scalding urination and three days later he had frequency of urination every hour, day and night, and a temperature of 103° F. These symptoms continued and after about one month he had sharp stabbing pains in the perineum, but none in the kidney regions.

Physical examination showed the patient to be well developed but rather poorly nourished. The skin was slightly pale although free from jaundice. The head, neck and chest were considered normal. The abdomen was symmetrically distended in the lower half. The liver and spleen were normal in size to palpation and percussion. The kidneys were not palpable nor was there any tenderness in the costovertebral angles. In the region of the bladder, there was an oval, slightly tender, cystic mass extending well towards the navel.

The external genitalia were within normal limits. The inguinal glands were not enlarged. The rectal examination disclosed a normal sized, soft, boggy prostate, the secretion of which contained many pus cells. Above the prostate was felt a thick walled cystic mass which was interpreted to be the bladder. The various reflexes were recorded as normal and there was no adenopathy. Temperature was 99.4 F., pulse 90 and respirations 20. Blood pressure was systolic 125; diastolic 80 mg.

Laboratory findings.—The red blood cells numbered 3,340,000; hemoglobin, 84 per cent; white blood cells, 7,000; polymorphonuclears, 51; lymphocytes, 44; large mononuclears, 2; eosinophiles, 3. Urine was cloudy, acid, with specific gravity 1.016, albumin +++, sugar 0. Microscopic examination revealed many pus cells and bacilli. Blood Wassermann and Kahn tests gave negative findings and non-protein nitrogen 29 mg. per cent. Phenolsulphonephthalein test given intravenously was 15 per cent in the first hour and an equal amount the second hour with an appearance time of twelve minutes.

Cystoscopy.—Catheterization of the bladder yielded 30 c.c. of cloudy urine. Attempt was made to examine the bladder by cystoscope but on introducing the instrument, an obstruction shortly after entering the bladder was encountered and nothing could be seen. The bladder capacity was 30 c.c. A plain roentgenogram of the bladder failed to show any abnormality or calcification. A cystogram was then attempted but only 5 c.c. of the medium could be introduced into the bladder.

Suprapubic cystostomy was performed by Dr. R. H. Jenkins, August 15, 1933. Having failed to make a diagnosis while the patient persisted to have marked dysuria, it was decided to open the bladder suprapubically. This was done under ethylene anesthesia. The bladder wall was found to be thin and its mucous membrane smooth but inflamed. The ureteral and internal vesical orifices were normal. There was no prostatic enlargement or contracture of the vesical neck. The bladder was collapsed behind the pubis by a tumor the size of a grapefruit involving the posterior bladder wall or lying behind it. The bladder was drained with a No. 36 F. wing catheter.

The patient's condition improved very slowly although he did not suffer any discomfort. He experienced chills and fever almost daily for the next two weeks. At the end of the third week the pyrexia subsided. In the meantime the red blood cells had dropped to 3.4 million and the hemoglobin to 62 per cent. A combined fluoroscopic and radiographic examination of the colon gave the impression of an extrinsic mass approximately at the level of the lumbosacral joint producing a pressure defect on the sigmoid. There was no evidence of osteoplastic bone lesion. An intravenous skiodan series showed moderate sized hydronephroses and hydro-ureters. The patient was given two blood transfusions of 300 c.c. each. His general condition

then improved remarkably and since there were no positive evidences of malignancy it was decided to explore the mass.

Operation was performed by Dr. C. L. Deming, September 8, 1933. The bladder was thoroughly irrigated through a catheter to insure as clean an operative field as possible. Palpation of the inside of the bladder revealed a large, smooth, tense mass, pushing the bladder forward to the pubis, and obliterating its cavity. The inside of the

Fig. 1. Photograph of seminal vesicle cyst.

bladder seemed to be absolutely smooth, regular and normal. The tumor was large, and filled the whole pelvis. The skin was then painted with Scott's mixture and the incision made through the old scar. The bladder wall was pushed downward. Several small openings were accidentally made into the peritoneum which were immediately closed. After a careful dissection and elevating the reflexion of the peritoneum, a smooth, cystic mass was encountered. This seemed to be tense, rather dark bluish in color, lying behind the bladder, between it and the peritoneal cavity. Much of the mass was covered with peritoneum, which was rather readily reflected on its upper portion. An area about 6 cm. in diameter was exposed. The cyst was then aspirated. The fluid contained a dark, chocolate colored matter which was rather thick, and under great pressure. After the cyst, which

contained about 1,000 c.c. of material, was emptied it was gradually dissected free, care being taken to protect the peritoneum, rectum, ureters and bladder. It seemed to be very adherent in its dependent portion and one could not discover its origin until the very last part of the dissection. Finally, it was found to be adherent to and formed a part of the right seminal vesicle. The whole cyst was removed, together with both seminal vesicles. There were a number of small vessels which were ligated, but very little blood was lost. By en-

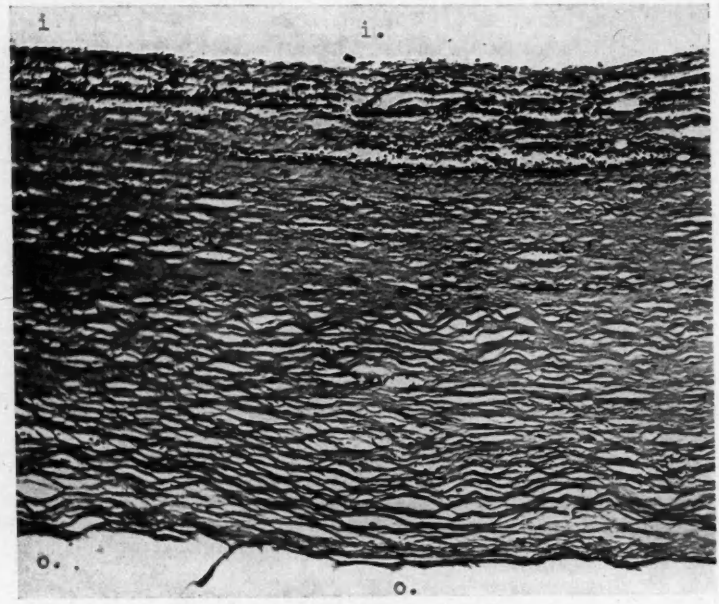

Fig. 2. Photomicrograph (X 125) of seminal vesicle cyst wall.
i: inner surface o: outer wall

larging the bladder wound its interior was clearly visualized. The ureteral orifices were located, and a catheter was passed up the right side without difficulty. The left ureteral orifice was seen to function, so that there was no doubt regarding the patency of the ureters. The posterior bladder wall and vesical orifice were normal. The postvesical space was drained with three cigarette drains and the bladder with a large rubber tube. The wound was closed in layers with two tension sutures of silver wire, and the skin with silk. The patient's condition remained very good, although the blood pressure dropped to 90/70.

However, the pulse remained at 84. A 350 c.c. blood transfusion was given immediately after the operation.

Prognosis was that if the patient did not suffer from immediate complications the end-result should be excellent.

Examination of the cystic fluid showed many old red blood cells, pus, many spermatozoa but no crystals. Culture was reported to be diphtheroids.

Convalescence.—The wound healed in six weeks. The bladder functioned normally although there was a slight infection with B. coli. A repeat examination with intravenous skiodan at this time showed a complete regression of the hydronephroses and hydro-ureters. The patient was discharged on October 25, 1933. He was seen six months later, at which time he had regained his former weight. The urine was free from infection and he was able to retain the urine all night.

Pathology.—Gross: The specimen consisted of a cyst which had been previously opened and filled with cotton. The former incisions had been sutured with interrupted black silk. The cyst was somewhat collapsed and measured 14 cm. in length, 9.5 cm. in width and 8 cm. in depth. The cyst had a smooth, glistening, white, translucent wall to which were attached some fragments of areolar tissue; except in the posterior inferior region in which there was a flattened piece of tissue measuring 5x3x5 cm. covered by a somewhat roughened white tissue and having the appearance of the right seminal vesicle. From this structure a tubular structure ascended superiorly and anteriorly in the wall of the cyst for a distance of 7 cm. and had been severed at this point. There was present a small portion of the left seminal vesicle in which the vas deferens had been severed at its juncture with the vesicle. On section the wall measured 0.2 cm. in thickness. The inner surface was smooth, white, glistening and translucent. There were no papillary masses present.

Microscopic: Preparations of the base of the cyst showed a segment of seminal vesicle cut longitudinally. The mucosa was thrown into folds and lined by fairly well preserved columnar epithelium. The lumen was empty. The circular and longitudinal muscle layers stained well. The outer covering was loose areolar tissue and was not remarkable in appearance. Preparations of the cyst wall showed it to be composed of dense, hyalinizing connective tissue. There was no epithelial lining.

CASE REPORTS IN THE LITERATURE

Damski.—A man forty-five years of age complained of difficulty in defecation. Rectal and abdominal palpation revealed a mass extending from the mid-rectal area upward on the left side to 3 cm. above the navel. The urine was normal and cystoscopy proved that the tumor lay dorsal to the bladder. Rectal puncture was done twice within

fourteen days, yielding 700 c.c. and 100 c.c. respectively of brownish, cloudy, odorless fluid containing much protein, epithelial cells, nucleated cellular debris but no spermatozoan. Six months later a marsupialization of the cyst to the rectal mucosa was done. This was unsuccessful and the patient returned in three months with symptoms of intestinal occlusion. A colostomy was done on the supposition that the lesion was malignant. An additional 100 c.c. of fluid was removed from the cyst. Its cavity was found to be smooth and its wall thick. No histologic examination of the cyst wall was made. The patient recovered.

Fisk.—A man thirty-five years old complained of bladder pain. Rectal palpation revealed a fluctuating tumor which almost filled the minor pelvis. The prostate was small and the bladder lay ventral to the mass. Abdominally the mass was found to be smooth and round. Rectal aspiration revealed 500 c.c. of brown liquid blood with pus cells, fat droplets and cholesterin, alkaline reaction, specific gravity 1.023, H_2O 91.06 per cent, solid water 0.94 per cent, ash 0.65 per cent, serum albumin about 6.0 per cent. The cyst was similarly emptied twice in the next six months, 100 c.c. and 50 c.c. of fluid being removed. There is no record of complications and a cure apparently resulted.

Francke.—Autopsy of a man sixty-nine years of age who had died of cerebral hemorrhage showed a cystic tumor of the minor pelvis measuring 12x15 cm. and extending up to the fundus of the bladder on the right side, displacing the bladder to the left and covered in its uppermost and medial aspects by peritoneum. The lower portion of the cyst rested on the pelvic floor. Pressure on the tumor caused slightly cloudy, fluid-containing spermatozoa to escape from the enlarged right ejactulatory duct. Sagittal section through the cyst showed three cysts, all communicating with each other. The outer wall of the cyst varied from 1 to 3 mm. in thickness, while the inner wall was about 2 mm. The opening of the ejaculatory duct was entirely free, as was the urethra. No stones were found. Microscopically the wall of the cyst was a thick tissue with very few nuclei; few short elastic elements; the epithelium was completely destroyed by decay and only in a single place were sloughed-off, cubical, epithelial cells found. The malformation was probably congenital.

Guitéras.—A young man of twenty-four years had had three attacks of pain in the lower abdomen with swelling. The tumor when first noticed was the size of an orange, above the pubis. It grew in one month to the size of a cocoanut and caused a heavy dragging feeling. Bimanual palpation revealed a tight tense cystic tumor the size of a football above the pubis. Catheterization of the bladder revealed only 3 ounces of clear urine. Aspiration of the cyst disclosed various fluids ranging in color from clear to a pea-soup green. A diagnosis

of pelvic kidney was made. Operation revealed a tumor 23 to 24 inches in circumference containing 3,000 c.c. of fluid. The cyst wall lay behind the bladder and was adherent to the pelvic floor. The fluid microscopically showed white blood cells, fatty granules and cholesterin. Marsupialization of the cyst was done and was followed by complete healing in one month.

Rolfe.—A married man of twenty-eight years had always been well up to four months prior to entry to the hospital. He first noticed pain in the hypogastrium and a small tumor in the midline above the pubis. This tumor gradually increased in size. He developed anorexia, loss of weight, with sluggish bowels, and died without treatment twenty-three days after admission to the hospital. Antopsy showed a large cystic tumor extending from the pelvis in the midline well above the umbilicus and laterally into the iliac fossa. The peritoneum and intestine were adherent to it. Walls of the cyst were one-fourth inch thick and on its inner surface was a soft fibrous and bloody layer 1.5 to 2 inches thick. The cyst was unilocular. The bladder was small and collapsed in front of the cyst. The rectum was empty. The vasa deferentia passed from the spermatic canal, crossed along the front of the tumor on each side, curving backwards and downwards over its upper end to the seminal vesicles. The left seminal vesicle was large and nodular and closely connected with the tumor at its back and lower part. The tumor lay behind the prostate between the bladder in front and the rectum and seminal vesicles behind. The right seminal vesicle was unaffected.

Smith.—A large pyriform tumor was found behind the bladder, extending above the umbilicus. On percussion it vibrated like a cystic tumor. The urine passed normally. Rectal examination revealed a normal prostate with the cystic tumor extending from the left seminal vesicle region. A diagnosis of hydrocele of the left seminal vesicle was made. A trocar inserted into the cyst by way of the rectum withdrew 10 pints of brown serous fluid. Four weeks later it became filled and was retapped. There was no recurrence.

Zinner.—An eighteen-year-old boy who complained of pain at the end of micturition for six months had never had intercourse. Cystoscopy showed a tumor cyst occupying the base of the bladder. A typical epicystotomy disclosed a "fist"-sized, greenish-blue, transparent cystic tumor which lay with a fold of normal mucous membrane on the ventral wall and covered up one-half of the trigone. The cyst was broken and a bloody, colloid serous content emptied. At the bottom of the monolocular cyst were greenish-yellow, mucous masses which appeared like pus. Cutting around the bladder mucous membrane the cyst was found to have a stalk 2 cm. long, thick as a match stick, extending to the right seminal vesicle. The cyst contained countless

CASE REPORTS

Name	Year	Age	Symptoms	Side	Size	Treatment	Result
Damski	1908	45	Difficult defecation	Left	700 cc. dark brown	2 rectal punctures in 14 days. 6 months later marsupialization to rectum—colostomy	Recurrent cecostomy done Cured
Fisk	1898	35	Bladder pain	0	500 cc.	3 rectal aspirations	Cured
Francke	1927	69	Autopsy	Right		Patient died of cerebral hemorrhage—autopsy	
Guiteras	1894	24	Swelling of lower abdomen with pain	Right	3000 cc.	Suprapubic marsupialization	Cured
Rolfe	1876	28	Pain in hypogastrium	Left		No treatment	Death due to infection
Smith	1872		Tumor of abdomen	Left	5000 cc.	Rectal aspiration 2 x	Cured
Zinner	1914	18	Pain at end of urination	Right	Size of fist. Sperms.	Epicystostomy and cystectomy	Died of pelvic infection
Deming	1934	59	Frequent urinations	Right	1100 cc.	Cystostomy Seminal vesiculectomy	Cured

non-movable partly degenerated spermatozoa, large clumps of blood pigment, and no leukocytes. The pus-like masses proved to be zoösperm. The cystic base was packed and the bladder drained. The patient died on the twenty-third postoperative day of necrotic purulent cystitis, pelviperitonitis and left pyelonephritis. Autopsy showed the left seminal vesicle normal. The right seminal vesicle was enlarged and closed in the lateral part and adherent at intervals to the dorsal wall of the bladder. Its cavity communicated with the bladder cavity. The right lobe of the prostate was one-third that of the left, which was considered normal. The right vas deferens terminated about 2 cm. above the ejaculatory duct. The match-stick-sized stalk cut out with the cyst was a part of the right vas deferens. The stump was connected with the medial edge of the seminal vesicle. Histologically the cyst wall extirpated showed seminal vesicle wall chronically inflamed on which only a portion of the epithelium was retained. The mucous membrane was replaced by degenerated fibrous granular tissue infiltrated with blood and in the deep layers with groups of round cells. Conclusion: A case of probably congenital atresia of the right ductus ejaculatorius resulting in retention cyst of the seminal vesicle which involved the musculature of the trigone before the last half of the fifth lunar month.

DISCUSSION

Origin.—Numerous theories have been advanced as to the origin of these cysts. They are single and never bilateral. All contain bloody fluid yet they seem not to be related to hemorrhagic prostatitis and vesiculitis or to hemorrhagic diseases. The rupture of any part of the pampiniform plexus would be and is quickly absorbed. There were no varicosities. They are not associated with cysts elsewhere. Tuberculosis and syphilitic lesions can hardly be confused with cysts of this type, although syphilis of the testis may cause a hydrocele of the tunica vaginalis. The Wassermann report of two of the eight cases was negative and the tissue removed from three was not tuberculous. Monod and Terrilon suggest, but give no examples, that the cysts may result from the swelling of the vas aberrans. Pellacani observed that the remains of the Wolffian bodies stretch along the vas deferens. Cyst of the inguinal region has been ascribed to the remains of the Mullerian duct, of the Wolffian bodies or enlarged lymph vessels, but more likely are due to the continuation of the obliterated peritoneal evagination. These cysts are hemorrhagic and contain sperm cells. They are not associated with diseases of the testicle, but are undoubtedly con-

nected with the vas deferens. It is much more logical to believe that they are caused by an obstructive process to the ejaculatory duct. They are probably congenital in the young and acquired in the older individuals. The bloody content is hypothetically produced by the distention of the cyst and bleeding within it. Malignancy was not a factor in any of the cases.

Location.—The usual situations for these cysts is between the bladder and the rectum. One involved the posterior wall of the bladder and trigone. They may be very adherent to the perineum, pelvic floor and bladder.

Pathology.—All but one cyst was monolocular. One is described as being composed of three cystic cavities, all communicating. They vary in size and contain anywhere from 500 c.c. to 5,000 c.c. of brownish colored, odorless fluid. Fisk described the contents as liquid brown with pus cells, fat droplets, cholesterin, alkaline in reaction, specific gravity 1.023, H_2O 91.06 per cent; ash 0.65 per cent; serum albumin about 6.0 per cent. Some contained spermatozoa in large numbers. The brownish color is due to the old blood content. There have not been any calcifications reported. The cyst wall is usually 3 to 5 mm. in thickness, except on top, where it may be very thin and bluish green in appearance. The wall is composed of fibrous tissue with few nuclei and short elastic elements. The inner surface of the cyst is lined with cuboidal epithelium which may be replaced by fibrous granulation tissue infiltrated with blood and in the deeper layers with small round cells. The wall of two showed seminal vesicle tissue. Francke's case showed no obstruction to the ejaculatory duct. That some cysts did contain spermatozoa clearly indicates the connection with the vas.

Incidence.—Seminal vesicle cysts are not confined to any one decade. Of the eight cases one occurred in the second decade, two in the third, one in the fourth, one in the sixth and one in the seventh. The right and left sides are equally involved.

Symptoms.—Pain is the outstanding symptom. It may be in the lower abdominal region in the form of attacks, bladder distress with burning and smarting, or pressure in the rectum with difficult defecation.

Three patients had lower abdominal distress while three others had normal urination. The rather acute onset of the symptoms suggests a rapid filling of the cyst from obstruction or by blood from hemorrhage. Rolfe's patient died in about five months after a progressive down-hill course of anorexia, loss of weight and urinary infection. Pressure upon the lower ureters by the cyst produces diminished renal function. Secondary anemia may ensue. There were no sex symptoms in the author's case.

Diagnosis.—The discovery of a cystic mass in the suprapubic region or on rectal examination or by bimanual palpation of the mass which is not a distended bladder may be suggestive. Because of its relative infrequence to other cystic masses in this region its diagnosis is obscure. A perineal or suprapubic aspiration of brownish serous fluid containing spermatozoa would be suggestive. Cystoscopy may be done where the cyst is not too large so as to collapse the bladder. The posterior wall of the bladder is encroached upon by a mass of retrovesical origin. So far a correct diagnosis has not been made pre-operatively. It is confused with a pelvic kidney, a distended bladder, hydrocele of the seminal vesicle and cyst of the vas deferens. Echinococcus cysts located in the retrovesical region usually cause retention of urine by pressure on the internal sphincter and do not cause a collapsed bladder. Diagnosis has been made at the time of operation after exposing the cyst behind the bladder.

Treatment.—The treatment at first was directed towards aspirating the cyst. Rectal punctures were first employed in three cases. Two cases had two and three aspirations respectively and were reported cured. The third had a marsupialization of the cyst wall to the rectum six months after two aspirations. In Rolfe's case, without treatment, the patient died of infection after five months. Zinner attempted a suprapubic removal of a cyst in a boy of eighteen years, but the patient succumbed on the twenty-third day of necrotic purulent cystitis, peritonitis and left pyelonephritis. In the author's case the patient had first a suprapubic drainage and when he had sufficiently improved a retrovesical extraperitoneal excision of the cyst was made with complete recovery. Marsupialization is the safest primary procedure. In Guitéras' case, healing

took place in one month. Rectal aspiration and marsupialization is to be deplored because of subsequent infection.

Prognosis.—Five of the eight patients recovered. Two died of infection, one for the want of treatment, and the other because of too much surgery. The prognosis should be good in all cases. If the renal function is impaired, a suprapubic cystostomy is advisable to allow the patient's general conditions to improve.

SUMMARY

1. A case of seminal vesicle cyst is reported.
2. Résumés of seven other cases are given.
3. Rectal aspiration of the cyst is to be deplored.
4. Suprapubic cystostomy with secondary extraperitoneal excision is recommended.
5. Marsupialization of the cyst suprapubically is favorably reported.
6. Excision of the large cysts without marsupialization or without suprapubic cystostomy is not to be commended.

BIBLIOGRAPHY

DAMSKI, A.: Cas d'un Kyste des vesicules seminales. Ann. d. mal. d. org. genito urin. Par., 981-987, 1908.
FISK, A. L.: A cyst of the vesicule seminalis: Aspiration by rectum. Ann. Surg., 28:652-654, 1898.
FRANCKE, H.: Ein Fall von multilokularen Samenblasenzyste. Zentralbl. f. Allgemeine Path. Urol. Pathol. Anat., 41:Nr4, 145-147, 1927-1928.
GUITÉRAS, R.: A case of sero-purulent cyst, probably of the right seminal vesicle. Lancet, p. 74, (July 14) 1894.
MONOD, C., and TERRILON, O.: Anatom. pathologique, p. 728, 1856.
PELLACANI, P.: Monod-Terrilon-anatom. pathologique, p. 729, 1856.
ROLFE: Tumor of the left seminal vesicle: undescended left testicle. Lancet, 782, (Dec.) 1876.
SMITH: Hydrocele of the seminal vesicle. Lancet, 11:A559, 1872.
ZINNER, A.: Ein Fall von intravesikaler Samenblasenzyste. Wien. med. Wchnschr., 64:605-609, 1914.

DIVERTICULUM OF THE PROSTATIC URETHRA WITH STONE

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Diverticula of the prostatic urethra, whether congenital or acquired, appear to be sufficiently uncommon to justify reporting. A search of the literature in the library of the New York Academy of Medicine revealed some half dozen such cases that might be considered authentic.

CASE REPORT

The patient, fifty-three years of age, a plumber by trade, was first seen by me November, 1932. He had been suffering acutely for several days from an overdistended bladder from which his urine was being expelled in drops, and with great difficulty.

His past history revealed nothing of interest to this report beyond a Neisserian infection when he was about twenty, which was followed by the characteristic story of stricture and periodic relief obtained by the ancient method of rapid expansion.

He was removed to the hospital, where gradual dilatation of his strictured urethra was instituted, and where a physical examination revealed the following additional pathologic changes: an infected urine, a four plus Wassermann reaction, and, according to the x-ray report, a stone in the bladder.

He was told upon leaving the hospital that after the stricture had been sufficiently dilated and his luetic condition favorably influenced by treatment, the stone could be removed.

Being a willing and coöperative patient, the treatment outlined was successfully carried out and in July, 1934, a cystoscopic examination was made to check the roentgenographic findings. The examination showed a pale, dull trabeculated bladder with two small apertures behind the right ureter mouth, but no stone.

A new set of stereoscopic x-ray plates was then made by another technician and the report again indicated stone in the bladder. Comparing these plates with the original pictures of one and a half years previous, nothing of interest was noted except the fact that the shadow had assumed a lengthwise instead of a transverse position.

After another negative check-up cystoscopy, several cysto-urethrograms were made. These clearly revealed not only a small vesical diverticulum, but a large prostatic urethral diverticulum. This group demonstrated the fact that the stone shadow was extravesical.

Fig. 1. Urethrogram showing diverticulum of prostatic urethra.

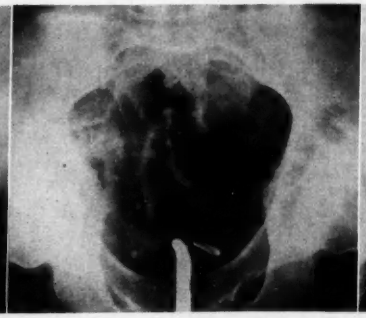

Fig. 2. Catheter curled in diverticulum by stone.

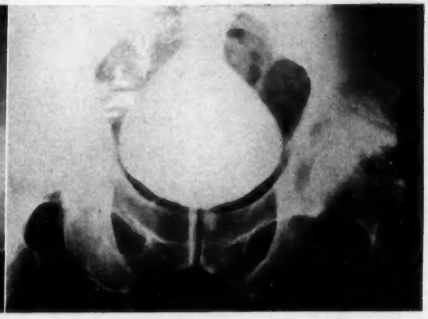

Fig. 3. Cystogram showing extravesical calculus.

A urethroscopy was then done which showed with brilliant clarity the orifice of the prostatic urethral diverticulum. This opening was about a quarter of an inch in diameter and to the left of the colliculus and in the middle of the lateral sulcus, about half an inch below the level of the utricle and ejaculatory ducts. It was a simple matter to pass a ureteral catheter into this pouch for a distance of an inch or more.

On a subsequent day the patient was prepared for operation. This was preceded by a preliminary urethroscopy and an attempt to pass a flexible forceps into the diverticulum on the chance of clicking against the stone and possibly grasping and withdrawing it, thus obviating an open operation. This not succeeding, the urethra was opened, under spinal anesthesia, and with the finger the stone was easily milked out of the pouch and delivered. Digital examination revealed the diverticulum to be a patch-pocket affair which might easily have been removed had I not reasoned at the time that with restored urethral caliber and drainage this would be of no particular advantage.

The wound was healed and the patient out of the hospital in a week, no better or worse than he was before as neither the diverticulum nor the stone had ever given him any uneasiness.

The pathologist's report stated that the calculus was very hard, covered by a thin brown layer under which the center was chalky white. The outer layer was composed of cellular debris and urates. The core and main bulk was calcium carbonate with a little earthy phosphate.

As the pyuria did not entirely clear up during the succeeding two or three months, I decided to obliterate the wall of the sac by fulguration. This was very simply carried out in two sittings.

In conclusion it may be said that this diverticulum seemed clearly to be of the acquired type and that it was occasioned by the urinary back pressure brought on by a distal urethral stricture. It seems probable also that the opening of a prostatic duct was the starting point of the diverticulum.

REFERENCES

ALCOCK, N. G.: A case of diverticulum of the prostatic urethra. Trans. Am. Assoc. Genito-Urin. Surg., 22:293-296, 1929.

COLOMBO, M., and WUGMEJSTER, I.: Formazioni diverticolari dell'uretra prostatica e disectasia del collo vesicale. Atti e mem. Soc. lomb. chir., 2:919-942, 1934. Abstr. Ztschr. f. urol. Chir., 40: Ref. p. 130-131, 1934.

DAVIS, D. M.: Chronic prostatis, its relation to anatomical changes in the prostate, prostatic urethra, and vesical orifice. Jour. Urol., 30:579-592, 1933.

GANSEN, G.: Divertikel der mannlichen Harnrohre. Bonn, 1905 (Inaug. Dissert). Cited by Priesel. Not in N.Y.A.M. library.

HEITZ-BOYER: Diverticules de la vessie et diverticule prostatique. Bull., Soc. franc. d'urol., pp. 119-128, 1934; also Urétrographe et formations diverticulaires prostatique. Ibid, pp. 46-65, 1935.

LOWSLEY and GUTIERREZ: Diverticula of the urethra. Revista de Medicina y Cirurgia de la Habana, (April) 1928.

MCKAY, R. W., and COISTON, J. A. C.: Diverticula of the male urethra; a report of ten cases. [Case 4, p. 54] Surg., Gynec. and Obstet., 48:51-62, 1929.

PEACOCK, A. H.: Diverticulum of the urethra containing a large calculus. Frequency of diverticula in the prostatic urethra. Tendency toward calculus formation. Surg. Clin. No. Amer., 4:1149-1156, (Oct.) 1924.

PRIESEL, A.: Die Missbildungen der mannlichen Geschlechtsorgane. In: Handb. d. spez. path. Anat. u. Histol. (Henke-Lubarsch) 6: pt. 3, 1-159, 1931 (p. 80). [Says they are exceedingly rare. Cites Schneider (Gansen's case).]

SCHNEIDER, P.: Die Missbildungen der mannlichen Geschlechstorgane, anatomische Teil. In: Handb. d. Urol. (v. Lichtenberg et al.) 3:91-172, 1928. [p. 135—Congenital diverticula of prostatic urethra very rare. Cites Gansen as probably only authentic reported case.]

WINSBURY-WHITE, H. P.: Prostatic pouch associated with congenital spinal deformity. Proc. Roy. Soc. Med., 25:542-543, 1932.

RECENT WORK ON THE PREVALENCE OF CARCINOMA OF THE PROSTATE

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About thirty years ago our attention was sharply called to the frequency of carcinoma of the prostate by Albarran. Shortly afterward, in a series of 150 cases of prostatic obstruction, we found in 10 per cent that carcinoma was present, in many cases entirely unsuspected and discovered only at perineal operation. In subsequent reports of a much larger series, we were surprised to find that carcinoma of the prostate was present in 21 per cent of the cases arriving at our clinic with prostatic obstruction. These figures caused not only great surprise, but doubt in the minds of many urologists. They were soon confirmed, however, by an important paper by McGrath, of the Mayo Clinic, in which the great frequency of carcinoma was confirmed. In numerous papers since then, not only from our clinic but elsewhere, the great importance of carcinoma of the prostate, not only on account of its frequency, but difficulty of recognition, has been pointed out.

Despite this extensive literature, the urologic world, I feel sure, was startled to read in a recent issue of the *Journal of Urology*[1, 2] two simultaneously published papers by Rich and by Moore, in which each author stated that in routine autopsies in men past forty years of age, carcinoma of the prostate was present, generally without symptoms, and without any evidence of its presence being recognized in 14 to 16 per cent of the cases. These amazing observations should make medical men, particularly urologists, keep in mind the great frequency of malignant diseases of the prostate and be on the outlook for early cases.

Rich reports that in 292 consecutive autopsies on males, fifty years of age or more, who died from a great variety of causes, carcinoma was found on examination of routine microscopic sections taken from the prostate in forty-one cases (14 per cent). These patients were from the medical, surgical and urologic services of the Johns Hopkins Hospital during the past three years. Only

one section was taken from the prostate in each case. In 34.2 per cent the disease had been recognized clinically, and the section taken from the carcinomatous gland. In 65.8 per cent of these forty-one cases the tumor had not been recognized clinically, in most cases being too small to have produced any symptoms, or to have attracted attention on rectal or cystoscopic examination. At autopsy a section was taken from the prostate, probably including the posterior portion in most of the cases. There is little doubt that if more sections had been taken from each gland, Rich would have discovered more cases of carcinoma. The number of cases discovered, however, indicates plainly enough that cancer of the prostate is much more frequent than any of us suspected. Among the 292 cases studied, eighty-two were from the urologic service, and among these, seventeen cases (21 per cent) of cancer of the prostate were discovered. Twelve of these cases had been recognized clinically, but five had not been recognized. In the cases between fifty-five and sixty years of age, 11 per cent showed carcinoma; between sixty-one and seventy years, 21 per cent; between seventy-one and seventy-five years, 28 per cent; between seventy-six and eighty years, 34 per cent; between eighty-one and ninety years, 20 per cent. Rich proved conclusively that there was no doubt but what he was dealing with a definite invasive carcinoma in each case.

In the same journal Moore reports a similar study which was made on 675 consecutive autopsies on male patients. His material was obtained from pathologic departments in two hospitals in Vienna during 1931-1932. In Moore's cases the gland was dissected free from the surrounding tissues, cut and fixed in 10 per cent formalin, and left uncut for ten days or longer. After that, blocks not over 4 mm. in thickness were cut and paraffin sections stained with hematoxin and eosin. In each of the 675 cases the entire gland was cut into blocks and one microscopic section was prepared from each block which was composed of routinely coronal sections. Horizontal and sagittal sections were cut in some cases. The blocks were not subdivided unless they were larger than 5x3 cm. By this section method, with the blocks in serial sections, all lesions larger than 4 mm. in diameter could be studied microscopically. Among the 675 cases there were fifty-two patients

under forty-one years of age, and in these no prostatic carcinoma was found. In 242 patients over forty-one years of age, the youngest in which carcinoma was found was forty-four years of age. In these 242 patients between forty-one and ninety years of age there were fifty-one cases in which carcinoma was found (21 per cent). The details of Moore's findings are given in Table I.

TABLE I. OCCURRENCE OF CARCINOMA AND BENIGN ENLARGEMENT

Age group	Prostates examined	Per cent which showed carcinoma	Per cent which showed benign enlargement	Per cent of carcinomas which arose in a prostate with benign enlargement	Per cent of benign enlargement which also showed carcinoma
21-30	24	0	0	0	0
31-40	28	0	4 (1)	0	0
41-50	23	17 (4)	30 (7)	25	14
51-60	65	14 (9)	37 (24)	50	21
61-70	77	23 (18)	67 (52)	66	23
71-80	63	21 (13)	68 (43)	46	14
81-90	24	29 (7)	75 (18)	71	27

Point of Origin and Preceding Lesions.—In fifty-two cases the lesions were small and an accurate determination of the point of origin could be determined. Fifty (73.5 per cent) arose in the posterior lobe, that portion of the gland posterior and posterolateral to the fan-shaped ducts which enter the sides of the urethra. Six (8.8 per cent) arose in the lateral lobes, that portion median and anterior to these same ducts. Ten (14.8 per cent) arose in the anterior lobe, that portion which drains into the anterior furrow of the urethra. None has been observed in the middle lobe, that portion between the urethra and deferential canal and cephalad to the colliculus seminalis. In one case there was complete carcinomatous infiltration of the middle lobe, but the posterior lobe was also involved, and the focus of origin could not be determined.

Moore says:

"In all cases except the two which arose in an area of benign enlargement, the area of carcinoma is surrounded and infiltrated by glands, typical of senile atrophy. The occurrence of this atrophy in non-carcinomatous cases follows closely the anatomical distribution of carcinoma and we believe that carcinoma of the prostate in the vast majority of cases results from stimulation and autonomous pro-

liferation of epithelium which has already undergone atrophy. Conversely, malignant transformation rarely occurs in a gland which does not show atrophy. In addition, carcinoma is rarely found in an area of complete atrophy with isolation of single epithelial cells.

"A study of the cases of carcinoma which arose in a gland also the seat of benign enlargement shows that the two disease processes

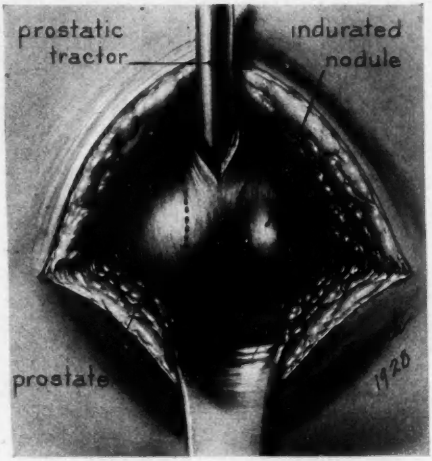

Fig. 1. Prostate exposed through perineum and drawn downward by tractor introduced through membranous urethra into bladder. Indurated nodule in right lobe, suspicious of cancer, excised (dotted lines) for frozen section and microscopic study. Examination proved it to be malignant. Radical operation carried out. (If examination had shown tissue to be benign, prostatectomy would have been carried out through bilateral capsular incisions.)

are not related. In the above tabulation the percentage of carcinomas in such glands is approximately the same as the occurrence of benign enlargement in the entire series."

By referring to Table I, it will be noted that the incidence of carcinoma in 675 cases was 16.7 per cent. In this series carcinoma was found much more frequently in the prostate than in any other organ, the next most frequent being the stomach, 6.2 per cent. In the larynx, colon, esophagus, gall bladder and lung the incidence of

carcinoma was between 1 and 2.5 per cent. That carcinoma of the prostate is far more frequent than carcinoma in any other organ is the most startling fact brought out in this splendid study, which is

Fig. 2. Young's radical operation for cancer of the prostate. Oblique view of prostate exposed after pushing anterolateral fascia to one side. Tractor is seen emerging from membranous urethra, which is shown being divided in *a*. In *b* anterior surface of prostate has been exposed by blunt dissection. Stump of membranous urethra, which has been completely divided, is shown. Prostate is being drawn downward by tractor.

accompanied by numerous photomicrographs, demonstrating without question the accuracy of the diagnosis of carcinoma.

"*Further Growth and Extension of Prostatic Carcinoma.*—In these fifty-two cases just detailed, there is no clinical or gross pathologic evidence of extraprostatic metastases. In four there is microscopic

invasion of the seminal vesicle, in three by an apparent direct continuity of malignant tissue and in one with an area between the primary focus and the vesicles, free of tumor. These four are the largest tumors of the fifty-two. Viewed from the standpoint of the general problem of invasion and metastases, carcinoma of the prostate exhibits early invasion of the perineural lymphatics within the organ but metastases and invasion outside the organ is a late manifestation of the disease.

"*Gross Diagnosis.*—In the fifty-two cases of occult carcinoma, the gross diagnosis was made in only ten. We believe that with another

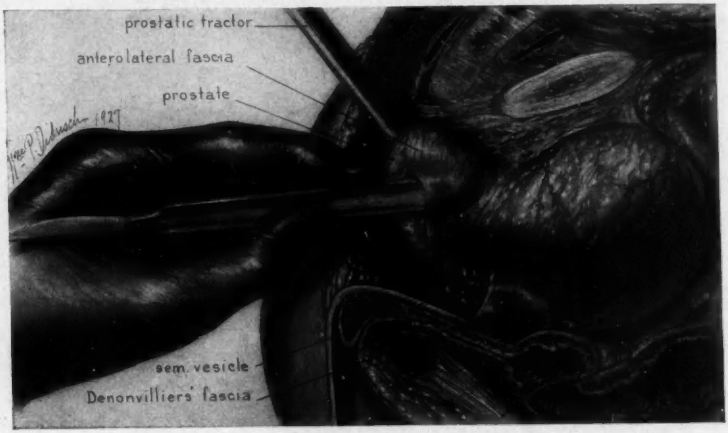

Fig. 3. Radical operation. Sagittal section showing separation of anterior layer of pelvic fascia from prostate. (This carries with it the great plexus of veins, arteries and nerves which lie behind the pubes.)

similar series a better percentage could be seen and diagnosed in the gross. The lesion is a firm white or whitish-yellow irregular mass, not sharply delimited from the surrounding tissue. Dependent upon the acinar differentiation and amount of desmoplasia it may be granular or fibrillar. In our experience there are only two confusion lesions, focal atrophy and hyperplastic tuberculosis. In the former the focal area is also not sharply delimited and firm, but it has a bluish-white translucent appearance. The latter is yellowish-white and usually has a moderately sharp scalloped border.

"Carcinoma of the prostate is intimately associated with senile atrophy and is derived from epithelial cells, which have previously undergone atrophy."

Moore views carcinoma of the prostate, therefore, not as a lesion associated with hypertrophy, but with that of atrophy. Our statistics and those of Moore show conclusively that the initial lesion is almost always not within the hypertrophied lobe, but elsewhere in the prostate. Moore says definitely that carcinoma and benign

Fig. 4. Radical operation. Beak of tractor drawing anterior wall of bladder forward after anterior fascia has been pushed away from bladder *(a)*. A knife is plunged through bladder in median line at its junction with prostate.

hypertrophy of the prostate are two distinct diseases, which occur independently. This is the position we have taken for many years.

In this report made by Moore, apparently cancer of the prostate had not been suspected in any of the cases. In Rich's report, seventeen cases of carcinoma came from the Department of Urology, but in all but five of these the presence of carcinoma had been recognized clinically. In these five cases the carcinoma was dis-

covered only at autopsy. These were very minute lesions, in which the patient had no prostatic symptoms, but carcinoma should have been suspected on rectal examination.

Cases, Diagnosed Clinically.—In one of my cases a small, very hard nodule, smaller than a pea, was felt in the posterior surface surrounded by elastic tissue. My radical operation was carried out and the patient is alive and well fifteen years later. Other cases of

Fig. 5. Radical operation. Trigone being divided at point about 1 cm. below ureteral orifice.

early carcinoma were detected, in which the lobule varied from 6 to 10 mm. in diameter. In some instances benign adenomata were present and seen with the cystoscope. In all of these cases the region invaded by the cancer was the posterior lobe and the nodule was palpable by rectum immediately beneath the capsule. The outstanding factor was very marked induration—third degree. Although the whole posterior surface of the prostate on rectal examination may show evidence of carcinoma, the posterior capsule, its encircling fasciæ are usually not invaded for a long time. The mucous membrane of the urethra and bladder are not invaded until late in the disease. Carcinoma of the prostate usually grows up-

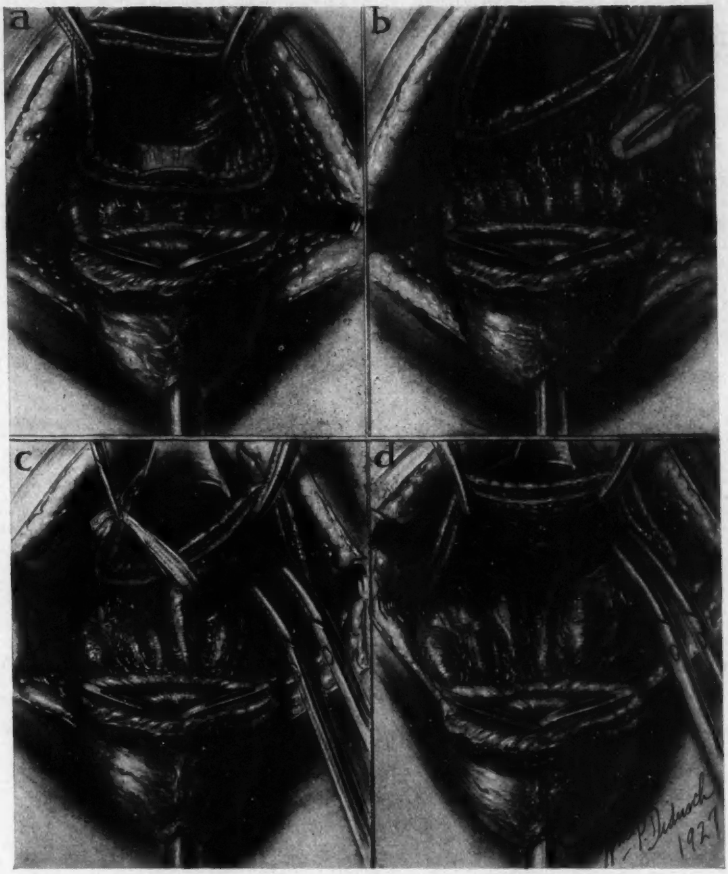

Fig. 6. Radical operation showing progressive stages in technic of pushing bladder and trigone upward and exposing seminal vesicles and vasa deferentia. *a*, Section begun; *b*, vesicles and vasa exposed by blunt dissection with a Kutner dissector; *c*, left vas deferens being picked up with tape and doubly clamped as high as possible, but well below ureter; *d*, both vasa have been tied and pedicle of left vesicle has been isolated and doubly clamped.

ward into the region behind the bladder, around or within the vasa deferentia and seminal vesicles. The mucous membrane of the bladder, although definitely elevated by the post-trigonal carcinomatous mass, is usually free from ulceration.

Hypertrophy was present in 57 per cent of my cases of carcinoma of the prostate subjected to the radical operation. In many of these cases the carcinoma had not invaded the capsule of the

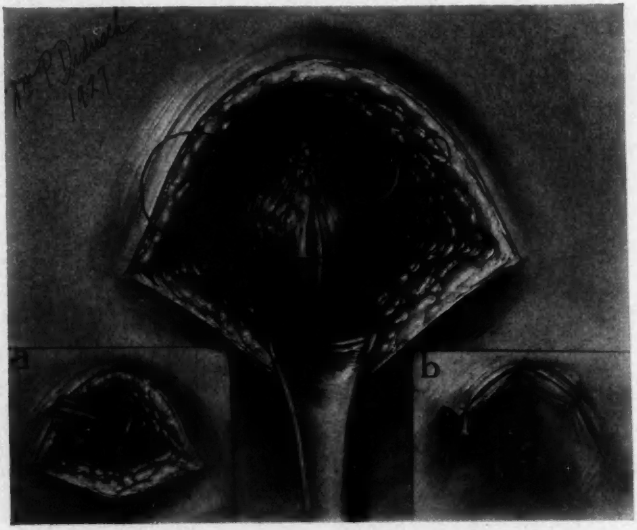

Fig. 7. Radical operation. Anastomosis between membranous urethra and vesical neck has been completed by a final purse-string suture in median line posteriorly, and remainder of bladder opening has been closed by continuous chromic catgut suture. *a*, Levator muscles are shown approximated with plain catgut. *b*, Drainage of retrovesical space is provided by two small tubes and suture of skin wound has been begun (silkworm gut).

adenomata, the two diseases being coexistent, and independent. In one case, however, we discovered carcinoma within an adenomatous lobe. This was reported by Shaw,[3] along with a thorough study of the literature.

Although Freyer reported a number of cases of carcinoma in prostates which had been enucleated suprapubically, a much greater

percentage of cases of carcinoma has been discovered in patients operated through the perineum. This is due to the fact that in the suprapubic operation the lateral and median lobes are enucleated, but the posterior commissure and posterior lobe are not disturbed, and it is here, as we first pointed out, that carcinoma is found in its incipiency in the great majority of cases. For the same reason specimens removed by my prostatic excisor or punch, or by the so-called resection method, may show only benign tissue. In the perineal operation, as the posterior portion of the prostate is the

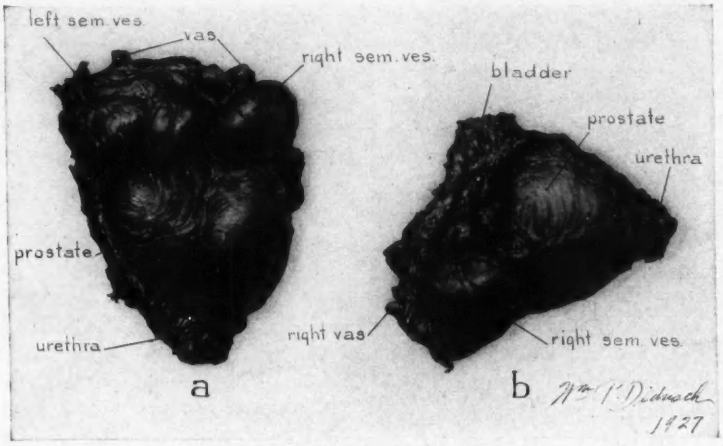

Fig. 8. Specimen removed by Young's radical operation. *a*, Posterior view showing portion of membranous urethra and prostate with its capsule, both seminal vesicles and ampullæ of vasa deferentia. *b*, Lateral view showing same, and cuff of bladder attached to prostate.

first exposed, the carcinoma, even though unrecognized on examination, is usually discovered at once. This accounts for our finding carcinoma in 21 per cent of the cases of prostatic obstruction.

If there were nothing to be done in a curative way with carcinoma of the prostate, even in its early stages, one might be justified in paying no attention to the frequency of cancer and carrying out the routine procedures for removal of the obstruction. But such is not the case; in fact, a method of radical cure is at hand for almost all favorable cases, and the operation cannot be evaded on the

ground that it is too dangerous. It is very little more fatal than other procedures on the prostate. In the last forty-two cases in which I carried out the radical operation, there were only two deaths, a mortality of 4.8 per cent, and a radical cure was obtained in 52 per cent of the patients followed over a period of five to twenty years. If we exclude the cases in which the prognosis was poor because the disease had progressed too far, the five-year cures would be over 70 per cent. Were it possible for physicians to realize the great frequency and importance of carcinoma of the prostate, the number of cases brought to early operation would be far greater, and the number of radical cures greatly increased. As a matter of fact, at the present time carcinoma of the prostate is rarely recognized until it is very extensive. In the great majority of patients who come to our clinic, the invasion has gone beyond the prostate and spread so far that radical operation is out of the question. Many of these cases had been in the hands of medical men, surgeons and even urologists without the presence of carcinoma being recognized. The technic of my radical operation is shown in the accompanying illustrations and described in the legends.

CONCLUSIONS

The papers by Rich and by Moore show that carcinoma is more frequent in the prostate than any other deep-seated organ; that it occurs in over 14 per cent of men past forty years of age.

Our statistics show that one-fifth of the patients, who come for relief of prostatic obstruction, have carcinoma; that carcinoma is usually in the form of a nodule or area beneath the posterior capsule in the posterior lobe; that in this position it is readily palpable by rectum and should be recognized by its great induration; that the perineum is the only route by which the diagnosis can be confirmed, and if the disease is not too extensive, a radical cure can be obtained; that our statistics show cures in over 70 per cent of the cases in which the prognosis was at all favorable.

Carcinoma of the prostate usually goes unrecognized for a long time. Practitioners should include examination of the prostate in every physical examination. If marked induration is present, it should at once make one suspicious of carcinoma. In such cases,

perineal operation to expose the prostate and confirm the diagnosis should be done.

If the medical profession could be made to realize the importance of these facts, many cases of carcinoma could be brought to operation sufficiently early for a radical cure.

REFERENCES

1. Moore, Robert A.: The morphology of small prostatic carcinoma. Jour. Urol., 33:224-234, 1935.
2. Rich, Arnold Rice: On the frequency of occurrence of occult carcinoma of the prostate. Jour. Urol., 33:215-223, 1935.
3. Shaw, E. C.: An early case of carcinoma of the prostate associated with benign hypertrophy. Jour. Urol., 11:63, 1924.
4. Young, Hugh H.: Tumors of the prostate. Practice of Surgery (Dean Lewis), W. F. Prior Company, Inc., Hagerstown, 8:1928.
5. Young, Hugh H.: The ultimate results in the treatment of carcinoma of the prostate by the radical removal of the prostate, vesical neck and seminal vesicles. Jour. Urol., 29:531-543, 1933.

DISCUSSION

DR. WILLIAM C. QUINBY (Boston, Mass.): I wish to compliment Dr. Deming on his interesting report and to add the brief details of a similar patient. This patient was approximately forty years old. He complained of pain in the perineum, especially if he sat on a cold object or if he were constipated, or occasionally after coitus. He had had gonorrhea followed by chronic prostatitis. I advised massage of his prostate on the assumption that he was suffering from gonorrheal prostato-vesiculitis. Some months later he returned, saying he was no better, but I could find nothing different from what had been determined at his first visit. About a year later, he returned for a third time. The urine containing evidences of infection and his story being a long one, I felt that it was justifiable to make an operative intervention. The perineum was incised and a prostatotomy was made through which the prostate was drained for two weeks. Convalescence was normal but he was no better. Again at the end of another year he returned, no adequate diagnosis having been made, but with this very definite and continuing history. I operated on him again, this time suprapubically as a frankly exploratory operation. A cyst which contained from 225 to 250 c.c. of a glairy fluid was found posterior to the bladder and below the peritoneum. It extended deeply behind the bladder, and from the suprapubic approach I was unable to remove the cyst in its entirety, as Dr. Deming has done. All except the lower portion was excised and the remainder cauterized with a chemical escharotic. Cure followed this operation. The tissue showed definite cyst wall undoubtedly arising from the seminal vesicle. Five years later this patient died of lymphatic leukemia. Autopsy showed an absence of the left seminal vesicle.

So far as the etiology of this condition is concerned, I feel that such cysts are usually developmental anomalies. It is known that of all the accessory genital organs the seminal vesicles are prone to more frequent variation in form, size and number than any other part of the genital tract. There are many instances of single seminal vesicles, of double ones on one side, or of branched, bifid ones. A developmental anomaly will explain them easily. Probably

the cases will fall into two groups according to whether or not infection has taken place. Most of them probably will be unrecognized if they do not cause obstruction or if there has not been antecedent infection. As I understand it, in Dr. Deming's case the blood and other material which the cyst contained were the products of infection of the cyst. In my patient there was no infection, but there were these obstructive symptoms.

DR. B. H. HAGER (Los Angeles, Calif.): I had hoped to hear Dr. Clark's paper and as a sequel present a case of what I believe to be a primary prostatic calculus. This individual was fifty-three years of age and he came to the hospital because of rectal disturbance of some three months' duration. He complained of rectal pain, perineal discomfort and rectal bleeding. The proctoscopic examination revealed no abnormalities. Because of the great amount of pus which he had in his urine, he was referred to the Urological Department, and in the course of the investigation it was noted that he had a moderately enlarged prostate per rectum and a definite crepitus could be palpated. The first roentgenogram showed a large shadow in the region of the prostate and the cystogram showed the relation of this shadow to the bladder.

(Slide) A cysto-urethrogram showed the relation of this original shadow to the bladder and to the urethra. The stone was removed and a surprisingly small amount of prostatic tissue. The stone appeared well encapsulated and was surrounded by a great deal of purulent material.

DR. EDWARD L. KEYES (New York City): Before you take that slide off the lantern, I should like to call the gentlemen's attention to the dorsal relation of that stone to the urethra, as to how far back it is. I am going to make some remarks on that.

DR. HAGER: There is apparently a communication between the cavity and the urethra inasmuch as some of the media can be seen surrounding the stone.

DR. JAMES PEDERSEN (New York City): In view of the case report just now submitted, I would mention a similar case that was referred to me last fall, in a patient forty-seven years old with a

diagnosis of tight stricture. It was a fact that nothing in the form of a catheter nor a sound could be passed into the bladder. The routine rectal examination discovered surprisingly marked crepitus; the x-ray showed three well developed calculi, the largest as big as the end of one's thumb; the smallest, the size of the tip of the little finger. I wish that I had the specimens here. My associates, Dr. Gutierrez and Dr. Conway, removed the stones skilfully, but the operation was difficult, because it had to be done without a guide and without traction or counterpressure from within the bladder until after the large stone had been removed and the way to the bladder cleared. The patient made a good recovery. His bladder function remains normal.

DR. EDWARD L. KEYES (New York City): I should like to ask Dr. Deming whether there has been gross infection in any of the reported cases as suggested as a possibility by one of the discussers because in handling a large uninfected cyst it might be more convenient to do the work through the peritoneum. Urologists are beset with an unwillingness to enter the peritoneum. For instance, the removal of the lower ureter through the peritoneum is fantastically easy as compared to ureterectomy done extraperitoneally, easier for both the surgeon and the patient.

I wish Dr. Young were here.

We are all so afraid of carcinoma. When I was born into urology, carcinoma of the prostate was carcinoma of the prostate and now we hear that metastases are late. My associate, Dr. Ferguson, has suggested that prostatic carcinoma possibly as much as any other carcinoma exhibits the influence of age in its prognosis. The older the patient the more slow-growing the carcinoma. The rapidity of the growth is certainly much less and much of the therapeutic triumph about cures of carcinoma of the prostate relates to tumors, the natural history of which, if let alone by the surgeon, would go quite as long as the patient's life has lasted after operation. It is improper for Dr. Young to report enthusiastically about his operation of prostatectomy without telling how long his patients survived and at what age the patients were when they were operated upon.

He did not mention diagnosis by aspiration biopsy. We all do aspiration biopsy, although this affords rather tenuous evidence of

a disease which may be difficult to diagnose when you have a gross specimen before you. I have heard a defender of aspiration biopsy make the statement that these two papers upon which Dr. Young's paper was a commentary were inaccurate because those gentlemen didn't know carcinoma of the prostate when they had the whole prostate under their hands; yet this critic can diagnose carcinoma of the prostate by aspiration biopsy! I withhold judgment.

I have seen a kidney removed because it had been seen by excretory pyelogram to have a bulge on it. An aspiration biopsy was taken. "Carcinoma" cells were found in the aspirated juice and the kidney was removed. It proved to be normal.

But surely you agree in discussing still further Dr. Young's remarkable statement that if he sees these patients early enough he can cure 70 per cent of them by prostatectomy. I don't care how early he sees carcinoma of the prostate, if he sees it late enough so that he can diagnose it, he can't cure 70 per cent by prostatectomy.

One should take the position that early carcinoma of the prostate cannot be diagnosed at all without counter-pressure on a sound in the urethra and cannot be diagnosed in any large percentage of cases without aspiration biopsy. It is surely essential that we should familiarize ourselves as well as possible with the technic of aspiration biopsy of the prostate so that we may be able by keeping close records of the accuracy of this diagnosis, to check up in later years the precision of this test.

DR. LEON HERMAN (Philadelphia): Will Dr. Keyes tell us the longest case of untreated carcinoma of the prostate that he has ever seen?

DR. KEYES: Ten years.

DR. HERMAN: Just before coming here an old doctor in Philadelphia, long retired (seventy-four I believe is his age), came to the Bryn Mawr Hospital with retention of urine and an enormous carcinoma of the prostate and I did a palliative drainage. I found that he had been seen six years ago by Dr. Pelouze, who made the diagnosis of prostatitis and after giving him several massages discovered a small pea-sized nodule in his prostate which he thought

was malignant. A month or two later it was found that the mass had increased about three times in size and a positive diagnosis of carcinoma was made. The patient refused treatment and had no treatment until I drained his bladder, which was six years later.

There are cases reported of longer duration, but I have encountered none.

DR. BENJAMIN S. BARRINGER (New York City): On the subject of carcinoma of the prostate I should like tentatively to disagree with almost all of the discussers, so that having got that off my mind I am free.

I think the importance of Dr. Young's paper to me is the reaffirmation that carcinoma does start in most cases in the posterior lobe of the prostate. Five years ago all of us believed that we had enough various kinds of material to prove it. We couldn't get all the autopsy material, the whole prostate, et cetera, to cut up, but we had material to prove that was so. Then the work of Randall, and in a lesser way the work of Ferguson, swung me a little away from this opinion. I began to think the carcinoma grew all over, that it always started in all four lobes, and rather rarely in the posterior lobe. I think the work of Moore unquestionably swings us to the fact that Young and Gerrity were right. It starts in most cases in the posterior lobe. There is a good deal of interest in the diagnosis and treatment of carcinoma. The posterior lobe is the easiest lobe to feel rectally. It is the easiest lobe to aspirate. It is the easiest lobe to treat with radium. I believe carcinoma does start in the majority of cases in the posterior lobe. It can start in the other lobes or it can have a multiple origin, but the posterior lobe is the one that I aim at. An aspiration biopsy of the lateral lobe or the median might be very difficult. The posterior lobe is right under the palpating finger and can be easily aspirated. I think the aspiration biopsy is of extraordinary value and I am quite surprised that Dr. Young hasn't taken it up and used it. As a differential diagnosis between prostatic carcinoma, non-carcinoma, tuberculosis and non-tuberculosis of the prostate it is of extraordinary value.

I had a case Dr. Beer sent to me a couple of years ago. This patient had not an irregularly sclerosed prostate, but one good solid big lump. There was no question of not getting into that lump

with an aspirating needle. I got several specimens of the lump and could not make a diagnosis of carcinoma of the prostate. The lump continues to this day. I don't believe the man has a carcinoma of the prostate and I so reported to Dr. Beer.

I believe that everyone should use the aspiration biopsy.

DR. EDWARD L. KEYES (New York City): How accurate is it?

DR. BARRINGER: Eighty per cent accurate. That is in 80 per cent of the cases you can get tissue of the prostate. Whether that tissue is exactly from the carcinomatous area would be very difficult to say. I suppose it would not be 80 per cent accurate for the carcinoma. In other words, in 80 per cent of the cases you get enough tissue of the prostate to make a diagnosis.

DR. KEYES: What proportion will you diagnose correctly?

DR. BARRINGER: I think you would diagnose all of them correctly, but you may not have gotten into the carcinomatous area. You will diagnose it either carcinomatous or noncarcinomatous, but you may have evaded the carcinomatous area.

I don't care to speak on the treatment of carcinoma of the prostate. Perhaps I have disagreed with Dr. Young often enough to let it lie there.

I am sorry I didn't hear Dr. Deming's paper on "Cyst of the Seminal Vesicle," because I had a very similar case of cyst, that I termed cyst of the prostate, which lay in the median line, held about 250 c.c., was not more on one side than on the other, and was beautifully diagnosed by aspiration. All that was necessary was to put a needle in it and 250 c.c. of fluid could be aspirated. I aspirated and played with it, I put carbolic in it once but finally I opened the bladder and simply did a modified diverticulum operation. I cut into the cyst, sutured the sides and it was all right.

I think that there is reason to suspect that these are cysts of the prostate rather than cysts of the seminal vesicles. We know the breast has similar cysts, retention cysts, and prostate tissue is analagous to breast tissue. There is no reason why there cannot be a retention cyst in the prostate. My reason for diagnosing it as cyst of the prostate is because it was exactly in the median line, and it went right to the prostate itself. It originated in the prostate area.

The main thing is not to make the diagnosis where the cyst comes from, but where it is going. Most of these cysts have malignant tendencies. I think they are an expression of malignant lesion of the prostate. My patient a year later developed carcinoma of the prostate at the origin of the cyst. I believe the prostate in such a case should be watched very carefully, as it very often undergoes malignant degeneration.

DR. NATHANIEL P. RATHBUN (Brooklyn, N. Y.): I want to stress what Dr. Keyes refers to as the timidity of aspiration in carcinoma of the prostate as a diagnostic measure and to cite two cases in which I did prostatectomy. In one patient I suspected malignancy at the time of the operation; in the other case, neither at the time of operation, before or after. Both of these patients returned about two years later, their bones riddled with carcinoma, one having no local evidence of occurrence and the other with the pelvis filled with carcinoma. Fortunately we had our specimens preserved entirely, and the pathologist went over them again and made literally hundreds of sections and could find no evidence of carcinoma in either case. One of those was carcinoma of the posterior lobe that hadn't been removed. The other case had no local evidence of occurrence.

DR. CLYDE L. DEMING (New Haven, Conn.): I appreciate the discussion of this paper.

There was no infection, Dr. Quinby, of the cyst fluid on the immediate smear, but the culture was reported to contain diphtheroids. I excluded cyst of the prostate in my discussion of this subject because the cyst wall does not contain prostatic tissue. However, in the lower portion of the cyst wall there was only seminal vesicular tissue, and in studying the series of cases it is difficult to differentiate some of those, but I included in my paper only those cases where there seemed to be positive evidence that we were dealing with a cyst of the seminal vesicle. There was no evidence of malignancy in the cases reported.

BILATERAL MALIGNANT LESIONS OF THE UPPER URINARY TRACT

CASE REPORTS

HOWARD S. JECK, M.D.

From the Second (Cornell) Division of Bellevue Hospital, New York City

According to the number of cases reported, metastasis of malignant tumors to the ureters by way of the blood stream or lymphatics is rare. In 1933, Kirshbaum collected reports of eleven cases, to which he added five of his own, including one case of Hodgkin's disease. Kirshbaum's cases were selected from a group of 622 tumor cases found at autopsy. Washburn informed the writer about the recent death of a patient of his who had a carcinoma of the prostate and died of uremia. Autopsy revealed bilateral metastatic cancer of the ureters. Various other authors cited by Woodruff,† together with Woodruff's own report, have brought the total number of cases up to approximately twenty-five, but in two or three instances there was some doubt as to whether or not the ureteral lesions were the result of true metastasis.

It is rather interesting to note that bilateral ureteral metastases have occurred about as often as unilateral ureteral metastases and that in the latter group the right ureter has been involved twice as often as the left.

I am presenting the first of the following two case reports primarily for its clinical interest rather than as a case report of a true bilateral metastatic lesion of the ureter. It is the opinion of the pathologist who performed the autopsy that this is a true metastatic lesion, but the evidence concerning this is not absolutely conclusive.

Case 1.—This patient, a man sixty years of age, was first admitted to one of the medical services of Bellevue Hospital in April, 1934, and thence transferred to the Urological Service in a semi-comatose state. His chief complaints were increased frequency of urination and constipation. The salient points in his history, covering a period

†Shortly after this paper was read. Woodruff in his paper entitled "Secondary Tumors of the Ureter: A Consideration of the Various Types with a Report of Two Cases," read on June 14, 1935, before the Genito-Urinary Section at the annual meeting of the American Medical Association (Atlantic City), presented a case of true bilateral metastatic cancer of the ureter, the primary focus of which was in the region of the vaginal fornix. This case was similar to the one herewith reported in that the patient had developed an obstructive anuria, which was due to metastatic bilateral ureteral cancer.

of approximately six months, prior to his admission to the Hospital are as follows:

1. Sharp intermittent pains in the left loin, followed by increased frequency of urination with polyuria (when in bed the pains were ameliorated by shifting his position from side to side).
2. Hemorrhage from the bowel lasting two to three weeks. Obstinate constipation.
3. Frequent vomiting, especially of fluids. At times he was able to retain nothing in his stomach.
4. Loss of weight, about 90 pounds, in the past six months.

Physical examination revealed a short, heavy-set individual with a thick chest and pendulous abdomen. Not only was he semicomatose, but also anuric. No urine could be obtained by catheter. The tissues covering his back, abdomen and legs were very edematous.

The non-protein nitrogen was 180. An emergency x-ray examination showed shadows suggestive of urinary calculi, one in the pelvic region of each kidney.

Believing in the probability that the anuria was due to bilateral calculus obstruction, as suggested by the shadows, ureteral catheterization was attempted. The bladder, however, was so filthy that neither ureteral orifice could be located. Nephrostomy, probably bilateral, was then considered as the most rational procedure. Since the flat radiograph indicated a very large left kidney and showed no outline of the right kidney, it was deemed wise to operate upon the left kidney first. Under spinal anesthesia, the left kidney was exposed by an oblique incision made parallel to the last rib. The structures of the loin were so edematous that much fluid escaped during the approach to the kidney. Immediately on incising the fascia transversalis, a large, round, smooth, tense mass presented itself in the wound. Assuming that the mass was the kidney, it was tapped by means of a clamp in a portion of the parenchyma which could easily be reached. This procedure released a large quantity of slightly purulent urine which had been under pressure. The opening was enlarged sufficiently to admit the index finger and the kidney pelvis was explored. No stone could be felt. Finally, a large soft rubber tube was inserted through the parenchyma into the kidney pelvis and secured by one suture through the kidney capsule. The wound was then partially closed around the tube. Inasmuch as this procedure required only a few minutes and the patient had apparently borne it well, the patient was turned over on the opposite side for a nephrostomy of the right kidney. There was so much edema that no bony landmarks, not even the spinal column, could be felt. The incision, therefore, was made more or less blindly and happened to be a little below the kidney pelvis. The ureter was easily identified and found to be about three times its normal size and very tense. Since it would have required a good deal of manipulation to have exposed the kidney itself a ureter-

ostomy was performed, the incision being made about 5 cm. below the ureteropelvic juncture. Immediately there was a gush of several ounces of urine which also was under pressure and slightly purulent. A soft rubber catheter, about No. 12 French in size with several holes in the end, was introduced into the ureter and pushed up into the kidney pelvis. This was brought out through the loin wound and

Fig. 1. Bilateral ureteral metastatic cancer. The kidneys were hydronephrotic and the portions of the ureters above the tumor nodules were greatly dilated.

fastened securely in place. A cigarette drain was placed down deep in the wound, which was partially closed in layers.

The patient was returned to the ward in very poor condition. A transfusion of 500 c.c. of blood was immediately given. The patient died six hours after the operation, about 8 ounces of urine having drained from the left nephrostomy tube.

Fortunately permission for an autopsy was obtained. Instead of the suspected calculi, the post mortem examination revealed a primary ulcerative carcinoma of the sigmoid with stenosis, with metastases to

the peritoneal nodes, liver and *both ureters.* Involving each ureter and completely blocking it was a spindle-shaped, smooth metastatic growth about 7 cm. long and 3.5 cm. wide at its greatest diameter. The growth involving the right ureter began about 6 cm. below the ureteropelvic junction and the growth of the left ureter was 4 or 5 cm. below that of the right (Fig. 1).

There is a well known and familiar saying that honest confession is good for the soul. It applies here. There are two confessions, in fact, and while I am reporting this chiefly because it adds another case to the list of bilateral carcinomata of the kidneys (whether primary in both kidneys or whether one growth is a metastatic manifestation of the other), there is a moral involved.

Case 2.—In October, 1934, a forty-seven year old man was admitted to the Bellevue Urological Service with the chief complaint of hematuria. There was a large, palpable, movable mass in the left upper quadrant which was obviously kidney. On cystoscopic examination, blood was seen coming from the left ureter. A retrograde pyelogram of the left kidney was very unsatisfactory. It showed only a small indefinite area or two of the pyelographic medium and did not prove much of anything. The pyelogram of the right kidney appeared at first glance to indicate that the kidney was normal.

Although the diagnosis of kidney tumor of the left side was quite obvious, we determined to obtain better proof before operating. Accordingly, another cystoscopy was done with much the same result. Blood was seen coming from the left ureteral orifice and apparently normal urine from the right. There was a great discrepancy in the function of the kidneys, the specimen from the right kidney containing 13 grams of urea per litre and that from the left side 3 grams of urine per litre. The second retrograde pyelogram (Fig. 2), which was made with great care, was hardly any better than the first, and it was then concluded that it would be impossible to obtain a more satisfactory pyelogram because of the probability that the kidney pelvis was filled with tumor tissue. Since the minute details pertaining to the case are irrelevant, the salient facts only are given.

A left nephrectomy was performed. The kidney was quite movable, not especially adherent and was therefore fairly easily removed. No trouble at all was experienced in tying the kidney pedicle.

The following day, about twenty hours after the operation, the patient died rather suddenly. There were hardly any indications of his impending death. When it was first noted that he had become unusually pale and his pulse was rather rapid, the wound was examined and nothing unusual was found. The dressing did not indicate any postoperative hemorrhage.

But a post mortem examination revealed that the patient had died

of hemorrhage. The following is the pathologist's description of his findings in the left kidney area.

"The site of the left kidney is occupied by a large semi-clotted retroperitoneal hemorrhage which measures approximately 25 x 12 x 7 cms. and the combined clotted blood and free blood weigh approximately 5 pounds. The left renal artery is seen to divide into two branches about 2 to 3 cms. from the aorta and these two branches are

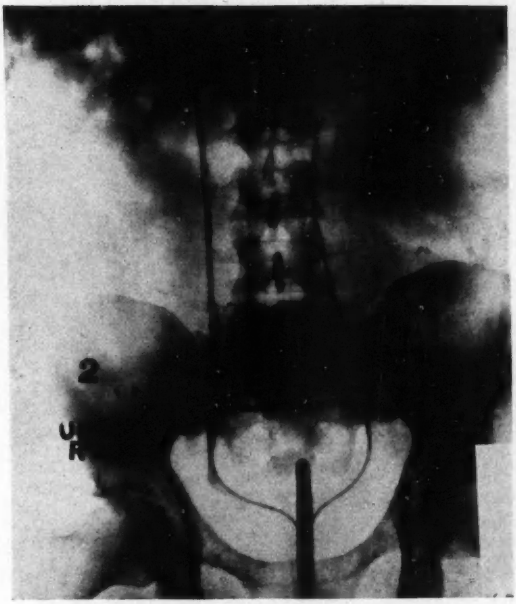

Fig. 2. Bilateral adenocarcinoma of kidneys. Only indefinite blotches of the contrast medium are shown in the left kidney region, while there is fairly definite defect of the right middle renal calix.

seen to be firmly ligated about 2 to 3 cms. from the division before mentioned—no leak or gaping could be demonstrated. However, there is a small branch given off from the superior branch of the division of the renal artery which runs laterally into the hemorrhage mass for a distance of about 5 cms. and on probing this artery, the distal end is seen to open in the area of the retroperitoneal hemorrhage.

"The right kidney is in natural position and of about average size. On the anterior capsular surface there is seen a round, soft, friable

mass measuring 5 cms. in diameter (Fig. 3). This mass has a smooth, fibrous capsule and section reveals a brownish very friable surface; there is no invasion of the kidney parenchyma. Sections of this kidney show kidney tissue which in one area is being infiltrated by a tumor process which consists of large epithelial cells tending to form abortive tubular and glandular elements. The cells are granular and moderately hyperchromatic; these are supported by a fibrous stroma. There are a very few hyalinized and fibrotic glomeruli. The epithelial

Fig. 3. Adenocarcinoma of the kidney removed at autopsy. The kidney was split longitudinally *(A)*, and then a transverse section was made through one of the halves *(B)*.

cells lining the tubules are slightly enlarged and granular, their free edge being somewhat irregular. Diagnosis: Adenocarcinoma."

The kidney removed at operation was almost completely infiltrated by a grumous mass, the histologic structure of which was so similar to the tumor of the kidney removed at autopsy that the pathologist in his report referred to the second tumor as a metastasis of the tumor in the kidney removed. When pressed for a reason why he called it a metastasis, he admitted that it was merely an impression and that it could just as well be a case of primary adenocarcinoma of both kidneys.

Naturally, I am not overcome with pride in reporting this case

and calling attention to a rather serious oversight, but to me it emphasizes the necessity of the care which must always be exercised in both diagnosis and treatment. We were so determined to get a good pyelogram of the left kidney, proving our diagnosis preoperatively, that we failed to give more than a passing glance at the right side, which was not under suspicion. It is needless to say that a second look at the pyelogram of this side would have aroused the suspicions of even the junior interne on the service.

As for the postoperative hemorrhage, it is conceivable that the vessel which the pathologist describes was probably a very small aberrant artery which was torn in freeing the kidney. Possibly, by virtue of the spinal anesthesia, the blood pressure was so low that the vessel did not bleed perceptibly and then as the effects of the spinal anesthesia later wore off, the blood pressure became sufficiently high to cause slow but constant bleeding.

Had the bilateral condition been suspected, I doubt that it would have changed our plan of procedure. The left kidney would probably have been removed anyhow, if for no other reason than to stop the bleeding from an organ which was obviously destroyed and a menace to the patient.

SUMMARY

Approximately twenty-five cases of true metastatic tumors of the ureter have been reported.

The writer reports a case of bilateral metastatic cancer of the ureters (probably true metastases from a primary focus in the sigmoid) causing obstructive anuria.

There is also reported a case of adenocarcinoma of the kidney in which the diagnosis was made clinically and the kidney removed. The patient died as a result of a concealed hemorrhage and autopsy revealed an adenocarcinoma of the opposite kidney, which, by an oversight, was not recognized pre-operatively.

COMMENT

Heretofore bilateral tumors of the ureter have received little or no attention clinically. It would seem now, however, that anuria due to bilateral ureteral tumor obstruction, while very rare, has been emphasized to an extent where it should be seriously consid-

ered in cases of obstructive anuria, especially those not caused by stone.

The second case reported emphasizes the fact that bilateral tumors of the kidney may exist oftener than is supposed. More attention should be directed to the supposedly sound kidney in ruling out malignant disease, than is ordinarily given it.

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REFERENCES

KIRSHBAUM, J. D.: Jour. Urol., 30:665, (December) 1933.

WASHBURN, W. J.: Personal communication.

WOODRUFF, S. R.: Secondary tumors of the ureter: a consideration of the various types with a report of two cases. Read before the Genito-Urinary Section, American Medical Association, Atlantic City, N. J., June 14, 1935.

THE LYMPHATICS OF THE LOWER URINARY AND GENITAL TRACTS

AN EXPERIMENTAL STUDY, WITH SPECIAL REFERENCE TO RENAL INFECTIONS

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A considerable amount of work has been carried out for many years by various investigators on the problem of the relationship of inflammatory lesions in the pelvic organs to coincident bacterial infections in the upper urinary tract. All possible methods of spread have in turn been held responsible, and even in the present day there is no unanimity of opinion. A physician may rightly speak in terms of blood spread, a gynecologist of lymphatic spread, a urologist of one or other or both.

The literature on infections of the kidney is very extensive, and, as has been tersely remarked, "is stupefying both in quantity and complexity."[3] The confusion arises to a great extent in the inaccuracy of terminology. To cite one instance, to a few workers ascending renal infection implies ascension from the renal pelvis into the kidney substance, and not the ascent from the lower to the upper urinary tract, as it does to the majority.

The source of infection has been maintained to be the most important consideration.[19]

A number of years ago the ascending theory predominated and the older writers were unanimous that infections reached the kidney from below, then Albarran's and later Rovsing's work indicated the blood stream. The consensus of opinion has now swung entirely with few exceptions to the origin being hematogenous and the study of infections of the kidney is now chiefly, though not wholly, directed toward the question of how organisms gain access to the kidney through the blood stream. This, however, is only part of the problem at issue.

Senator[21] states, "All that causes an inflammation of the lower part of the genito-urinary tract, before all, a cystitis, has an etiologic bearing on pyelitis and pyelo-nephritis." This once more leads to debatable ground as to the origin of the primary infection,

the cause of its deposition, and then its method of spread within the genito-urinary tract.

An infection in any organ in the bony pelvis may be coincident with or precede a renal infection. The difficult task is to explain the relationship which there undoubtedly must be.

The general agreement today is that cystitis at least is never primary and that infection comes from some other source either within or outside the genito-urinary system.[2]

Beyond doubt also, certain factors do favor localization of bacteria in both the pelvic organs and the upper urinary tract. These may be congenital anomalies, acquired abnormalities, trauma, calculus, et cetera, together with general conditions, *e.g.*, pregnancy, constipation.

A considerable amount of the experimental work carried out on the problem loses value because of the lack of proper controls, which are essential to reasonable deductions. Considering the conflicting theories and experimental findings, the most appropriate approach is along the stepping stones of clinical research progress.

Observers from time to time have called attention to the possibility that bacteria might reach the kidney by way of the lymphatics. Though the theory of such an invasion has not received general support, a variety of publications has been produced showing careful anatomic and experimental studies. Some of these have supported, others have disproved the theoretic contentions. Those in favor hold that the lymphatics play a very important part in the transportation of infection from the organs of the bony pelvis upwards.

Following upon the old views on intraluminar ascent of infection, a further theory was advanced that spread took place by direct continuity along the ureteral mucosa through a continuous lymphatic network. Thus began a series of investigations of the lymphatic relationship of the pelvic organs to the upper urinary tract.

HYPOTHESIS OF LYMPHATIC RELATIONSHIP OF KIDNEYS TO PELVIC ORGANS, ESPECIALLY THE BLADDER

In the first place, though much work has been done on the subject, many still hold that lymphatic spread from the bladder to the kidneys has never satisfactorily been proved, and state that, anatomically, the segmental character of the lymphatic system about

the ureter makes direct transportation of bacteria from the bladder to the kidney improbable.

Mascagni,[16] in 1794, demonstrated the lymphatics of the upper ureter draining into the lymphatic system in the region of the kidney pelvis and suggested the possibility of organisms reaching the kidney along these paths. He also showed that the lymphatics of the lower ureter drained into the lymph nodes in the bony pelvis.

Teichman,[26] in 1861, and Kraus,[13] in 1876, were more concerned with the presence of lymphatics in the ureteral mucosa. Later, Gerota,[9] in 1894, using Prussian blue for injection, studied the bladder and ureteral lymphatics very completely.

Stahr,[22] in 1900, demonstrated the anastomosis of the lymphatics of the ureter with those of the kidney pelvis and substance.

Sakata,[20] in 1903, carried out a series of experiments and came to the following conclusions:

1. "No network of lymph vessels was demonstrated in the mucosa and submucosa of the ureter.
2. "In the muscle sheath and on the external surface of the ureter, there were well developed lymph vessels, lying parallel to the blood vessels.
3. "The afferent lymph vessels were present chiefly in the central or middle portion of the ureter and went to the lumbar glands which lie both beside and anterior to the aorta and vena cava, and internal to the common iliac artery.
4. "The lymph vessels of the lower section of the ureter went either directly into the hypogastric glands or else they united with the lymph vessels of the bladder.
5. "The lymphatic unions between the bladder and kidney were not direct, but existed either by the interposition of the regional glands of the bladder and kidney or by means of the lymph vessels of the ureter.

"The vessels of the ureter communicated with the vessels of the kidney and bladder. There were two ways of indirect communication.

"a. By way of hypogastric lymph glands and the lumbar glands.

"b. The lymph vessels of the ureter communicated at the upper and lower ends with the vessels of the kidney and bladder respectively."

The author stated that the lymph vessels were so situated and connected that they offered a favorable means of transmitting infection from the bladder to the kidneys, especially as they were capable not only of transmitting infection through the walls of the ureter, but also through the regional glands, which acted as connecting links between the lymphatics of the bladder, ureter, and kidney.

He also stressed that the chain of lymphatics between the ureter and bladder was not continuous, but highly interrupted. Organisms, therefore, to reach the kidney, would have to pass through several systems of lymph nodes, a contingency decreasing the probability of such a happening.

In 1910 Bauereisen[1] stated:

"The kidneys and bladder stand in much closer relation to one another, through the lymphatics of the ureter, than one has heretofore supposed. We have placed in the right light a previously hardly ever mentioned path for the infection of the kidney and ureter."

He deduced from his work that:

1. There is an anastomosing network of lymphatics in the wall of the bladder and ureter communicating with a similar network in the renal pelvis and parenchyma, and at the lower end communicating with the lymphatics of the pelvic structures in both male and female.

2. Infection of bladder and lower ureter might reach the renal pelvis or kidney by the ural lymphatics.

3. From the kidney the perirenal tissues might become involved through the capsular lymphatics, which anastomose with those of the cortex.

Kumita[14] substantiated Bauereisen's findings that the lymphatics of the bladder, posterior urethra and lower ureter passed to the hypogastric nodes; those of the midureter to the lumbar nodes, and those of the kidney hilus, upper ureter, and fatty capsule drained into the aortic nodes above and below the renal vessels. This work was also confirmed by Müller.[18]

Sugimura,[24] in 1911, in a study of a series of autopsies concluded from his findings that infection ascended from the bladder to the kidneys by the ureteral lymphatics.

Following experiments, Stewart[23] reported in 1910 as follows:

"Ascending infections of the kidney quite often take place through either the lymph or blood vessels of the ureter. When infection takes place in this way, it seems almost positive that the lymph vessels of the ureters are the carriers of the infection. The lumen of the ureter is less often a factor in ascending infection of the kidney than had previously been supposed."

Later, in 1914, in combination with Sweet,[25] he suggested that, once infection was established in the genito-urinary tract, it spread entirely by the lymphatics.

Summarizing the work of Eisendrath, Kahn and Shultz,[7,8] inflammatory infiltrations seemed to follow the course of the lymphatics as previously determined by Kumita and Bauereisen. Hess[11] also confirmed these findings.

Working from the knowledge of the frequent association of chronic pelvic inflammation in women with upper urinary tract infection, Winsbury-White,[28] in 1933, injected pigment into the cervix of female guinea pigs. He stated he was able to follow the dye ascending in the peri-ureteral tissue where the main lymph pathway lies. Previous to this work K. M. Walker[27] had injected foreign particles or organisms into the urethra of animals. His results were such as to favor the idea that the particles travelled to the upper extremity of the ureter by way of the surrounding plexus of lymphatics.

Carson[4] demonstrated cancer cells in the perivascular lymphatics of the ureter secondary to primary carcinoma of the bladder, prostate and cervix uteri, and in the perivascular lymphatics of the renal pelvis from primary carcinoma of the prostate. In his experimental work infection was produced at the lower end of the ureter and was held to pass upward through the peri-ureteral lymphatics to the kidneys.

The work already quoted would tend to indicate that organisms were easily transported from the bladder to the kidneys by the lymphatic vessels in the peri-ureteral sheath. From the lymphatics of the ureter the infection would seem to pass to the lymphatic vessels of the renal pelvis, then by continuity to the network of intrarenal lymphatics, and even to the perinephritic tissue through the communication of lymphatics of the cortex with those of the true fatty capsule of the kidney.

All workers do not agree with these findings. David and Matill,[5] though aware of the extensive lymphatic network in the region under discussion, emphasized the fact that the drainage of the bladder, ureter and kidney was segmental into the lumbar and hypogastric nodes and into the nodes along the renal vessels. The ready flow of lymph was not from the bladder, through the ureter to the kidney or vice versa. They admitted the theoretic possibility of the peri-ureteral lymphatics as a route for extra-urinary infections, *e.g.*, from pyosalpinx, appendicitis.

Cabot and Crabtree[3] also declined to follow the investigators who

claimed to have demonstrated ascension of bacteria by the lymphatics from the bladder direct to the kidney with production of renal infection, and offered fair and honest criticism of such deductions, criticism built mainly on a framework of sound anatomic observations.

The lymphatic currents throughout the body follow the flow of the blood in the blood vessels. Unless this doctrine is disregarded, difficulty arises in tracing lymphatic processes over areas which are totally lacking in continuous vascular channels. There are no blood vessels running in an uninterrupted course from the bladder to the kidney. The blood supply of the ureter is distinctly segmental.

Graves and Davidoff[10] also remarked that on anatomic grounds there was little evidence of extension of infection up the ureteral lymphatics, and even the amount of experimental work done had failed to prove satisfactorily that infection ascended along this channel.

Such then is a summary of the previous work on the subject.

From the important rôle that lymphatics play in infection in other parts of the body, it seems reasonable that, on occasion, they must take an active part in the transportation of lower urinary and genital infection.

The object of this paper is a study of the path of this transportation by the lymphatics and the position of the kidneys in relation to this path.

As an introduction to the work, a brief description of the gross physiology and anatomy of the human lymphatics of the area under discussion will be given.

GROSS PHYSIOLOGY[6]

The essential interest in lymphatics lies with their function in absorbing fluid and particulate matter from the tissue spaces. They collect foreign material, which is then lost in the lymph nodes or returned to the blood stream.

The lymphatic circulation is constantly in action. As William Hunter, in 1784, suggested, the function of the lymphatic capillaries is essentially absorptive, that of the blood capillaries productive and absorptive. Lymphatics deal constantly with extravascular protein and any material unabsorbable by blood vessels.

Absorption of blood proteins is their main task and, in infection, removal of cellular detritus, particles of dirt, et cetera.

GROSS ANATOMY[12]

Lymph Glands of the Abdomen.—These may be divided into three chief groups: (1) Those in the folds of peritoneum; (2) those in pelvis, and (3) those in the back wall of the abdomen proper.

Of these only groups 2 and 3 are of interest in the present study.

The lymph glands of the pelvis receive lymph from the contents and walls of the pelvis, and from the thigh and buttock. They transmit it to glands on the posterior wall of the abdomen. They lie (a) in front of the sacrum, especially along the middle sacral artery; (b) between the bladder and pubis, and at the side of the bladder along the umbilical artery; (c) around the hypogastric artery and around the roots of its branches; (d) around the ampulla of the rectum, under its fascial sheath; (e) in the pelvic mesocolon and broad ligament.

The glands that are spread over the posterior wall of the abdomen receive lymph from the contents and parietes of the abdomen and pelvis, from the lower limbs and external genital organs; their terminal efferents from the lumbar and intestinal trunks. They are most numerous and form chains or groups in the following situations of interest to the present study: (a) around the aorta and inferior vena cava; (b) between and alongside the common iliac arteries; (c) around the external iliac artery.

Lymph may have to traverse several glands before reaching the lymph trunks. Generally speaking the glands near an organ are the first to receive lymph from it. Exceptions are those of the testis and epididymis, ovary and uterine tube which drain along the perivascular lymphatics to glands alongside the aorta and vena cava at the level of the kidney.

The intestinal and lumbar trunks join the cisterna chyli, which lies in front of the upper two lumbar vertebræ between the aorta and right crus of the diaphragm.

PERSONAL WORK

Having completed a long but necessary picture of the problem as it stands, the questions remain: To what extent are renal in-

fections due to lymphatic ascent, and do the lymphatics form a direct connection between the bladder and the kidneys?

In the first place, the mass of evidence which tends to show that the peri-ureteral lymphatic ascent will account for a considerable number of the cases of upper urinary tract infections, is a striking feature. The explanation seems almost too simple.

From a developmental point of view it is contrary to what one would expect. The ureteric bud appears in embryos of about 5 mms., and grows first dorsad and then cephalad. By six weeks the pelvis has advanced opposite the second lumbar segment in the retroperitoneal tissue. The drainage would therefore be expected to take place either medially or downwards. There may be an apparent anatomic communicating network, but a physiologic continuity is improbable.

The original plan in experimental work was an attempt to obtain absorption from the bladder and to follow the route of absorption. Thence the study would be taken to other areas and the results compared, especially in relation to the presence or absence of spread toward the kidneys.

Rabbits were used throughout and the anesthetic employed was either intramuscular urethane or intravenous nembutal.

Owing to the difficulty of controlling bacterial experiments in animals and forming reasonable deductions, foreign particles were used for injection. These could be followed macroscopically and microscopically and an analogy could therefore be drawn between their behavior and those of bacteria. A colloidal solution of carbon or India ink was requisitioned and filtered through hard filter paper before use.

As the study was to be one mainly of absorption, a series of dissections of normal tissue was made to find out accurately the disposition of the lymphatics of the pelvis and posterior abdominal wall in rabbits. The dissections were carried out in a regular method which will be described in detail.

TECHNIC

The rabbit was first killed with chloroform. The abdomen was opened and the intestines and associated digestive glands removed after ligating their vessels. A cannula was next inserted into the abdominal aorta and the animal perfused with normal saline until

the fluid returning from the inferior vena cava was clear. The next step was the removal of the peritoneum and fascia off the muscles on the posterior abdominal wall, along with the kidneys, ureters, aorta and vena cava. The dissection commenced just below the diaphragm and was continued to the brim of the bony pelvis. Then the whole of the pelvic contents was shelled out *en masse*. The thin sheet of tissue plus pelvic organs was stretched out on a cork mat with pins and placed in formalin for twenty-four hours. The careful stretching out is a very essential step, since with the shrinkage of the tissues in formalin, the ureters, especially the right, become approximated to the lymphatic chains around the aorta. Particles in these chains may therefore appear to be in the peri-ureteral plexus unless careful technic is observed. (Note also that this shrinkage takes place even if the tissue is fixed *in situ* on the muscles.)

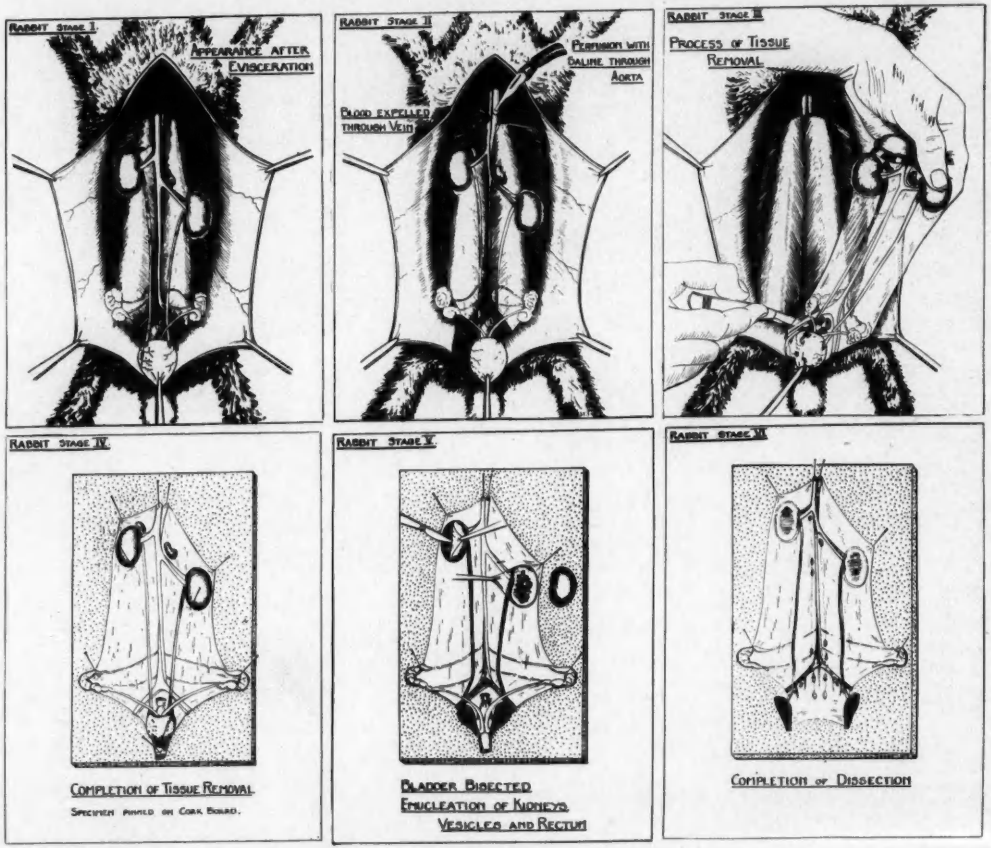
The pelvic organs were then dissected. First the bladder was bisected, and each half retracted laterally to expose either the uterus and tubes or the ampullæ of the vasa and the seminal vesicles. These were carefully dissected free and removed. The peritoneum and pelvic fascia were incised around the rectum and the rectum enucleated. The thin pelvic peritoneum and fascia were left as a thin sheet with the two halves of the bladder drawn laterally. At the same time the kidneys were enucleated from their capsule and removed.

The specimen was returned to formalin for a further twenty-four hours. The tissue was then removed and fixed to a large glass slide, and dehydration in 94 per cent alcohol commenced. After twenty-four hours it was put in absolute alcohol for forty-eight hours, and then in chloroform to clear.

At a variable period depending upon the amount of fat to be dissolved the sheet of tissue was removed and placed under the binocular dissecting microscope and the peritoneum carefully stripped off along with any foreign material such as muscle tags.

The lymphatic vessels and glands were dissected free, commencing at the bifurcation of the aorta and working upwards and downwards. The specimen was then either mounted on a slide with a large cover-glass for future microscopic purposes or placed in a narrow specimen jar for future macroscopic study.

After carrying out a series of normal dissections, names were



Figs. 1-6. Technic of lymphatic demonstration.

given to the various groups of glands. These were most conveniently classed in relation to their adjacent blood vessels. A dissection of the pelvic blood vessels was made in a rabbit. The abdominal aorta divides into the two common iliacs and these in turn into the external and internal iliacs. The internal iliac gives off a superior vesical branch, then an inferior vesical branch and continues on as the obturator artery. In the angle between the two

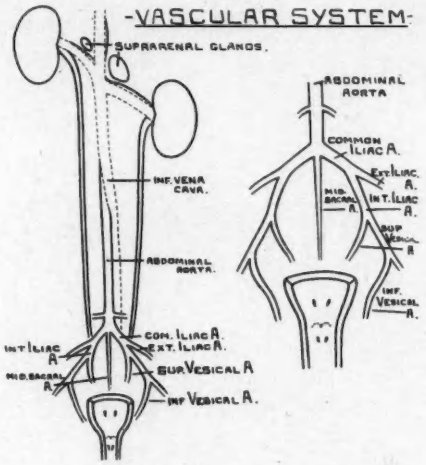


Fig. 7. Vascular system of rabbit.

common iliacs running caudally in the middle line is the middle sacral artery.

The lymph glands have been classed as follows:

The sacral glands lie usually, but not constantly, in the hollow of the sacrum behind the upper part of the rectum, one on either side of the middle sacral artery. These are not constant.

The inferior vesical glands are situated between the inferior vesical artery and the obturator artery. These are not constant. One may be present.

The superior vesical glands lie in the angle between the superior vesical artery and the continuation of the internal iliac artery. These also are not constant. One may be present only.

Mention might here be made that a false impression is likely to

be taken from the position of those glands in the finished specimens as the structures are enclosed in the conical bony pelvis in their normal surroundings and now have been forcibly stretched on a flat surface. Relations to organs have been disturbed, but not to the blood vessels from which they have been named.

The internal iliac lymph glands usually comprise two groups, one above and one below the bifurcation. They may, however, be fused

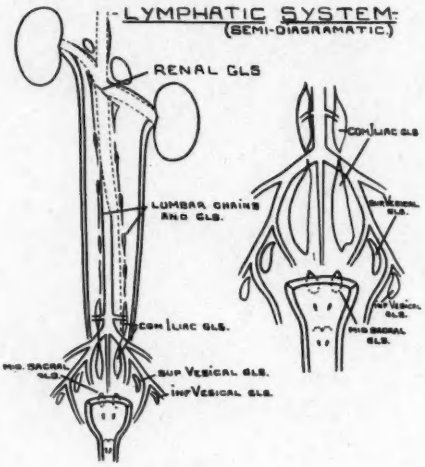


Fig. 8. Lymphatic system of rabbit.

into one mass lying either anterior or posterior to the arteries. Occasionally one group lies on a distinctly more superficial plane than the other. From the region of the bifurcation of the aorta two lymphatic chains pass up to the renal glands. The left chain is usually the more distinct as the right often lies in front of the artery. The chains may communicate and may even fuse. They are usually interrupted by a variable number of small lumbar glands.

The renal glands usually have the form of an isosceles triangle with the apex downwards and lie in the inferior angle between the renal vein and the vena cava. The right lies cephalad to the left. It may be situated ventral or dorsal to the vena cava. If the latter, it lies at a much deeper plane than the left.

The glands at times, even in ordinary dissections, have a darker

color, especially the renal. This is due to the presence of small brown granules and can easily be distinguished from the jet black of India ink particles. Further, any blood left in the vessels after inadequate perfusion turns dark and is likely to be confused with dye.

Experiment 1.—India ink was passed through a catheter into the lumen of the normal bladder. No trauma was caused and the animal

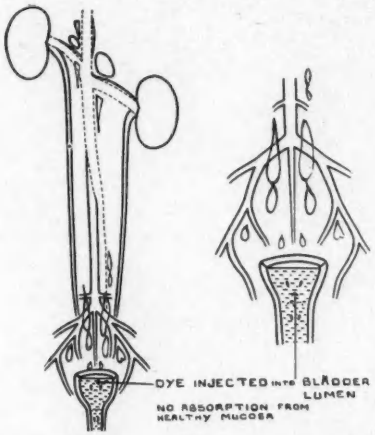


Fig. 9. No absorption from healthy bladder.

was left for one week. The animal was then killed, perfused, and the tissue already described removed. Careful examination and dissection under the binocular microscope revealed no trace of dye either in the lymphatics or bladder wall.

Experiment 2.—The bladder mucosa was traumatized by physical or chemical means or by bacterial toxins, then dye introduced into the lumen. In most cases small amounts of dye could be traced in the bladder wall, but no satisfactory absorption was obtained. This tends to indicate the resistance of the bladder wall to infection and that stout reactionary barriers are put up to prevent toxic absorption. In a few cases where a fulminating ulcerative cystitis resulted, dye was found in the lumbar chains within twenty-four hours.

Experiment 3.—The bladder was approached through a small suprapubic incision and a small quantity of India ink, 0.1 c.c. to 0.2 c.c., was injected through a fine needle as accurately as possible into the sub-

mucous coat of the bladder. A series was carried out and one of three areas chosen for injection in each case:

(1) Trigone of the bladder;

(2) around both ureteral orifices;

(3) around the bladder neck, both on the vesical side and on the urethral aspect.

In an attempt to hasten absorption, different procedures were employed. In some cases a bead was introduced into the bladder to produce as much activity and motility in the tissue as possible. In other cases the dye was mixed with streptococcal toxin. In neither

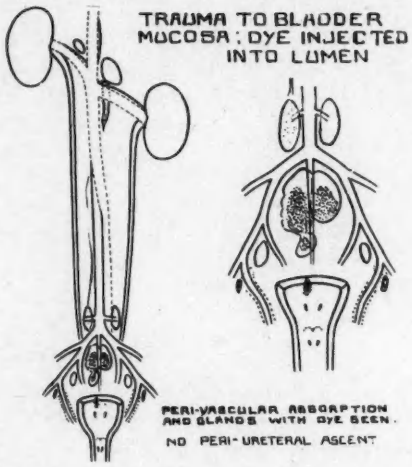


Fig. 10. Absorption from traumatized bladder.

instance, however, was there any appreciable increase in the absorptive rate, so the dye was used alone in most of the series. The animals were left for periods varying from seven to ten days.

The striking feature was that the appearance of the ureter suggested that no dye passed up either the lymphatics of the ureter or of the peri-ureteral network, no matter what the site of the original injection. Whether the dye was placed around the intramural portion of the ureter or at the bladder neck was of no significance.

The findings were arrived at only after careful examination under the binocular microscope.

Microscopic sections of the kidney parenchyma, kidney pelvis, and ureteral walls were negative for dye.

The glands varied in the extent of their involvement, but the path of absorption was invariably to the internal iliac group at the bifurca-

tion of the aorta, thence along the aortic chain through the lumbar glands up to the renal glands.

Summary of Experiment 3.

(a) Dye injected into trigone. Dye passed to the common iliac group of glands, thence upwards along the abdominal lymphatic chains.

(b) Dye injected into the bladder wall around the ureteral openings. Dye passed apparently upwards around the loose tissue surrounding the first two millimeters of the ureter, then swung in to the glands at the bifurcation of the aorta, and thence up the abdominal chain to-

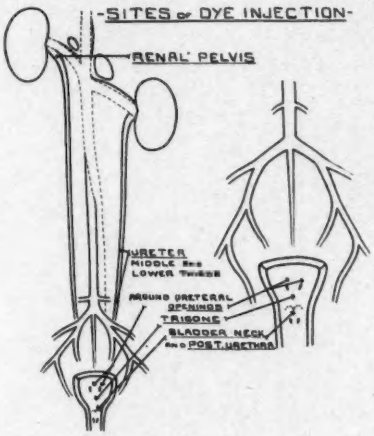


Fig. 11. Site of injection of dye.

wards the renal glands in the angle between the vena cava and renal veins.

(c) Dye injected into the bladder wall around the bladder neck and posterior urethra. Dye passed to the common iliac group of glands, thence upwards in the same manner as the previous two groups.

One specimen (rabbit No. 9) demonstrated very clearly two of the methods by which dye passed from the bladder. The dye had been injected into the bladder wall around the ureteral openings. On the right side, the ureteral wall was perfectly clear and the dye had passed along the perivascular lymphatics of the inferior vesical artery. On the left side the dye had apparently passed into the peri-ureteral network, thence almost immediately collected into two bundles, one passing medially anterior and the other medially posterior to the ureter to get to the common iliac lymph nodes.

Experiment 4. Dye was injected into cervix. An attempt was first

made to inject the dye into the cervix from the vaginal aspect. This proved most difficult to accomplish accurately. In later studies the organ was therefore approached through a suprapubic incision.

The result was as in the previous experiments, a drainage of the dye towards the common iliac group of glands and thence upwards along the aortic chain.

Experiment 5.—Dye was injected into the lower third of the ureteral wall. A suprapubic incision was made and the peritoneum opened and the lower thirds of the ureters identified. India ink (0.05 c.c.) was

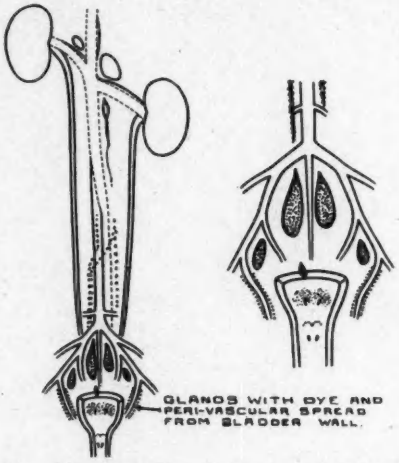


Fig. 12. Absorption from around ureteral openings.

then injected into the lower third of the ureteral wall. The animal was left for fourteen days.

The result was rather striking. The movement of the dye was toward the midline and there was no apparent attempt to follow the course of the ureter. The lumbar portion of the abdominal chain contained dye.

Dye was injected into the middle third of the ureteral wall and the animal left for fourteen days.

Dye was passed to the lumbar chain, apparently by perivascular lymphatics.

Although not part of one's personal investigation, the work of Dr. D. M. Morison, Edinburgh, on lymphatic absorption from the ureter might be summarized,[17] to complete this part of the picture.

"A patchy area of dye absorption was found in the middle third zone. The dye appeared to lie in fine channels running at right angles to the long axis of the ureter, probably coursing along the periphery of the ovarian or spermatic vessels to reach the lumbar glands.

"In the upper third the patches of dye absorption appeared to connect with vessels running toward the renal pelvis. From the renal pelvis dye passed along behind the main renal vein and communicated with the lumbar glands."

The previous experiments tending to indicate the unwillingness of foreign particles to ascend along the periureteral lymphatics and

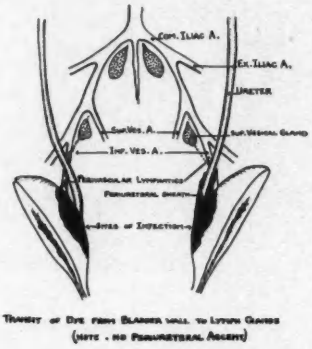


Fig. 13. Path of transit of dye from bladder to glands.

the apparent constant drainage along the main aortic abdominal chains, Experiment 6 was an attempt to open up subsidiary pathways.

Experiment 6.—A midline incision was made over the central part of the abdomen. The small bowel was packed upwards and the descending and pelvic colons laterally. A satisfactory exposure of the lower portion of the abdominal aorta was obtained. The parietal peritoneum was incised and the upper half of the terminal inch of the aorta was stripped to break the two main lymphatic chains on both sides. The ends were then seared with the cautery in order to prevent as far as possible any leakage of lymph or tissue fluid and rapid repair.

The object was to ascertain whether, on destroying the lymphatic highway, any by-paths opened up, especially any tract along the ureters leading to the kidneys.

Having finished the dissection of the aorta, 0.25 c.c. of India ink was injected into the bladder wall around both ureteral openings. The animal was left for fourteen days.

The result again was quite definite. Dye was absorbed into the common iliac group of glands and stopped where the aortic chain was divided. What was most illuminating, however, was the fact that no dye was seen along the ureters. As a result of the lymph blockage, there was a marked lymphatic edema of the pelvic organs with suffusion of dye. In addition, surrounding the traumatized area of the lower end of the aorta, numerous fresh lymphatic vessels had arisen and these were all seen to be passing towards the midline and none

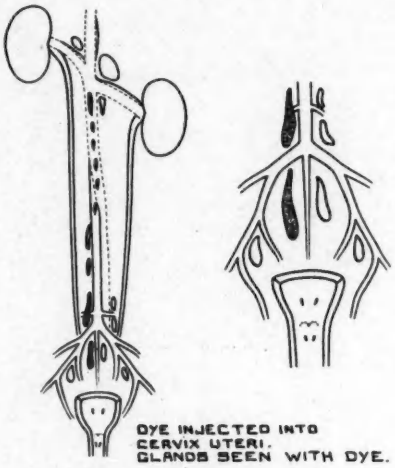


Fig. 14. Absorption from cervix uteri.

draining to the ureter. A small lymph chain had opened up posterior to the aorta in an attempt to drain the pelvic edema.

Experiment 7.—The lower end of the right ureter was tied off, and dye injected around the lower end of the left ureter.

Following upon MacKenzie and Hawthorne's observations[15] that dye in small quantities passes through the renal circulation, but is deposited when the circulation is slowed as in hydronephrosis, an experiment was framed to make use of these facts.

The previous experiments had tended to show no evidence of direct lymphatic spread to the kidneys. The assumption was that the dye passed directly through the lymphatic chains until eventually it reached

the venous system. The site of the junction of the lymphatic and venous systems in animals is an inconstant factor. The lymphatic chain may pass into the vena cava at any level, or it may form a thoracic duct in the usual way and follow the course in the human.

Through a suprapubic incision, the lower end of the right ureter was tied off. (Here it may be stated a hydronephrosis was produced by this procedure and not an atrophy of the renal substance.) A small quantity of dye, 0.2 c.c., was injected into the bladder wall around the left ureteral opening. The animal was killed in four weeks' time. A right-sided hydronephrosis was found. Dye had been absorbed and

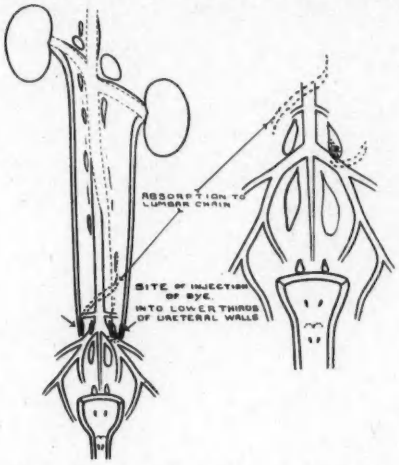


Fig. 15. Absorption from lower third of ureters.

had passed up along the left aortic chain from the point of injection on the left side.

The right kidney was removed and sectioned.

Appearance of Section.—Dye was present in the intertubular capillaries, the glomerular vessels, and in the cells of the proximal convoluted tubules.

This experiment tended to show that the dye reached the blood stream from the lymphatics, then passed to the kidneys. That the dye did not reach the renal parenchyma by the blood stream on the original injection is supported by the small quantity of dye injected and the fact that the hydronephrosis was not at that time a reality. Had dye reached the kidney at that time it would have passed through.

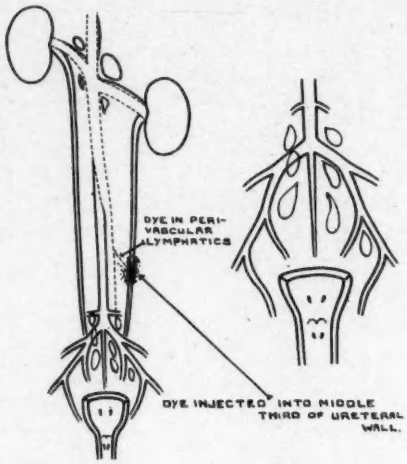


Fig. 16. Absorption from middle third of ureters.

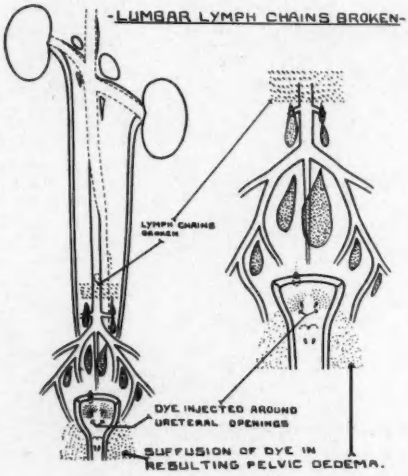


Fig. 17. No subsidiary path, if main chains are broken.

Experiment 8.—Dye was injected around the renal pelvis. The animal was killed in one week's time. The dye was found to have moved toward the lumbar chain of lymphatics.

RESULTS OF EXPERIMENTS

The result in every experiment was a lymphatic absorption of dye, no matter what the site of the original injection. In each case the dye passed to the lymphatic chains running up along the

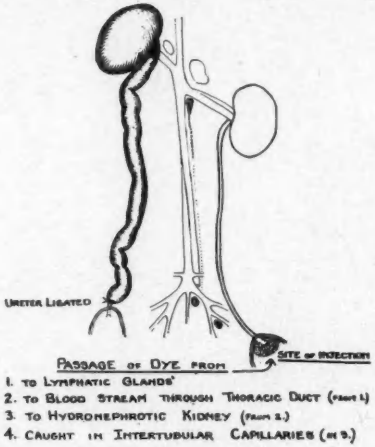

URETER LIGATED
PASSAGE OF DYE FROM
SITE OF INJECTION
1. TO LYMPHATIC GLANDS
2. TO BLOOD STREAM THROUGH THORACIC DUCT (FROM 1)
3. TO HYDRONEPHROTIC KIDNEY (FROM 2.)
4. CAUGHT IN INTERTUBULAR CAPILLARIES (IN 3.)

Fig. 18. The lympho-hematogenous spread.

aorta. No dye could be found in any instance passing up the ureteral wall nor along the peri-ureteral lymphatics.

CONCLUSIONS

Dye injected in small quantities in rabbits to different areas of the bladder wall, different levels of the lower ureteral wall, and into the cervix, is absorbed and passes to the common iliac group of glands either directly or through interposed smaller nodes. The dye then passes upwards towards the thoracic duct, and the implication from one series was that the dye then passes to the blood stream to the kidneys.

SUMMARY

A method of preparing the lymphatics of the posterior abdominal wall in rabbits which maintained the anatomic relations of surrounding structures, has been described.

A series of experiments was carried out in rabbits on the rôle of the lymphatics in the absorption of dye from some of the pelvic organs, and the relation of the upward drainage to the kidneys.

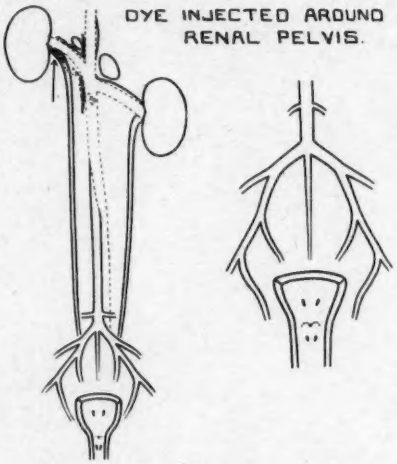


Fig. 19. Absorption from the wall of the renal pelvis.

1. No absorption was obtained from the healthy mucosa of the bladder.

2. There was no marked absorption after varied forms of trauma to bladder mucosa unless an acute ulcerative condition was produced.

3. Dye injected into the trigone, around the ureteral openings, and around the bladder neck passed to the glands at the bifurcation of the aorta through the lymphatic vessels.

4. Dye injected into the wall of the lower third of the ureteral wall passed towards the lumbar glands to the main lymphatic chain.

5. Breaking the continuity of the main lymphatic pathway by stripping around the termination of the aorta does not lead to the

opening up of subsidiary peri-ureteral lymphatic routes, but causes a lymphatic edema of the pelvic organs.

6. Tying off the lower end of one ureter leading to a hydronephrosis and the simultaneous injection of dye into the bladder wall around the lower end of the other ureter results in the absorption of dye into the aortic chain as before, and suggests its passage thence into the venous circulation to the heart and thence to the kidneys. Dye was caught in the hydronephrotic kidney.

7. Dye injected around the renal pelvis resulted in absorption to the lumbar lymphatic chain.

BIBLIOGRAPHY

1. BAUEREISEN: Beitrag zur Frage der aszendirerenden, Nieren-Tuberculose. Ztschr. f. Gynaek. u. urol., 11:132, 1910; Ueber die lymphgefässe des menschlichen Ureters. Arch. f. Gynaek. u. urol., 11:235, 1910; Ztschr. f. Gynaek. u. urol., 4:124, 1913.
2. BELFIELD, W. T.: Note on the etiology of chronic cystitis. Chicago Med. Rec., 3:94, 1892.
3. CABOT, H., and CRABTREE, E. G.: The etiology and pathology of non-tuberculous renal infections. Surg., Gynec. and Obstet., 23:495-537, 1916.
4. CARSON: Ascending infection of the kidney. Amer. Jour. Urol., 26, (Dec. 3) 1906; Metastatic carcinoma of the ureter. Ann. Surg., 82:142, 1925, and 86:549, 1927.
5. DAVID and MATILL: The rôle of the ureteral lymphatics in experimental urinary tract infections. Arch. Surg., 2:153, (Jan.)1921.
6. DRINKER, C. K., and FIELD, M. E.: Lymphatics, Lymph and Tissue Fluids. Balliere, Tindall & Cox, 1933.
7. EISENDRATH, D. N., and KAHN, J. V.: The rôle of the lymphatics in ascending renal infections. Jour. A. M. A., 66:561-564, 1916.
8. EISENDRATH and SCHLUTZ: The path of involvment in ascending infection of the urinary tract. Jour. Med. Research, 35:295, 1917.
9. GEROTA: Zur Technik der Lymph Gefässinjection. Anat. Anzeiger, 12:211, 1846; Ueber die Anat. und Physiol. der Harnblase. Arch. f. Anat. u. Physiol. u. abt. 1897.
10. GRAVES and DAVIDOFF: Studies on the ureters and bladder with especial reference to regurgitation. Jour. Urol., 10:185-231, 1923.
11. HESS: Mitteilungen an dem Grenzgebiet der Medizin und Chirurgie, Vol. 26.
12. JAMIESON, E. B.: A Companion to the Manuals of Practical Anatomy. Humphrey Milford, 3rd Edition, 1932.
13. KRAUSE: Handbuch der Menschlichen Anatomie, 1:5248, 1876.
14. KUMITA: Lymphgefässe der Nieren-und Neben-nieren Kapsel. Arch. f. Anat. u. Physiol. anat. abt., p. 49, 1909; Über die Lymphbahnen des Nierenparenchyms. Arch. f. anat. u. Physiol. anat. abt., p. 94, 1909.
15. MACKENZIE, D. W., and HAWTHORNE, A. B.: Some studies in the distribution of blood-borne foreign particles, including bacteria, in the kidney. Trans. Amer. Assoc. G.-U. Surgeons, Vol. 21, 1928.
16. MASCAGNI: Vasorum lymphaticorum corporis humani historica et ichnographia, 1:5248, 1876.
17. MORISON, D. M.: Routes of Absorption in Hydronephrosis. Brit. Jour. Urol., March 1929.

18. MÜLLER: Untersuchungen über die Ausbreitung des Entzündlichen Prozesses im nierenparenchym der aufsteigenden Pyelonephritis. Arch. f. klin. chir., 97:14, 1912.
19. NECKER, F.: Handbuch der Urologie, Berlin: Springer, 1929, 3:690.
20. SAKATA: Über den Lymphapparat des Harnleiters. Arch. f. Anat. u. Physiol. Anat., abt., p. 1, 1903.
21. SENATOR: Quoted by V. C. David. Ascending urinary infections. Surg., Gynec. and Obstet., 26:159, 1918.
22. STAHR: Der lymphapparat der Nieren. Arch. f. Anat. u. Physiol., p. 41, 1899.
23. STEWART, L. F.: A study of ascending infection of the kidney. Univ. Penn. Med. Bull., (July-August) 1910.
24. SUGIMURA: Ueber die Beteiligung der ureteren, an den akuten Blasenentzundungen, etc. Virchow's arch. f. pathol. anat., 20:206, 1911.
25. SWEET, J. E., and STEWART, L. F.: The ascending infection of the kidneys. Surg., Gynec. and Obstet., 18:460-469, 1914.
26. TEICHMAN: Das sangader system, 1861, p. 590.
27. WALKER, K. M.: The paths of infection in genito-urinary tuberculosis. Lancet, 1:435, 1913.
28. WINSBURY-WHITE, H. P.: The spread of infection from the uterine cervix to the urinary tract and the ascent of infection from the lower urinary tract to the kidneys. Brit. Jour. Urol., 5: No. 3, (Sept.) 1933.

A CONSIDERATION OF TESTICULAR PROSTHESIS

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The subject of testicular prosthesis has received but little attention if one is to judge from the scanty literature. Apparently Hermance, an American surgeon, was the first to conceive and execute the idea of implanting an artificial testicle. This operation was performed in February, 1886, but was not reported until 1894. Meantime the French surgeons, notably Tuffier and Reynier, took up the idea in about 1891 or 1892, reporting several cases. The most exhaustive discussion of the subject during the days of its infancy was made by Salles in his Bordeaux thesis of 1896.

Following these leaders case reports appeared by Humbert in 1893, Guiteras and also Weir in 1894, Burmeister in 1902, Guinard in 1903, and Lexer in 1904. From this date there seems to be no reference to the subject until the appearance of Gelpi's very comprehensive report in 1917. This author was able to collect fifteen cases, to which he added one of his own. In the discussion of this paper, Chassaignac reported one case and I have found two others, which together with a personal case about to be reported makes a total of twenty. I feel sure, however, that there are still quite a few more which have not been recorded.

A study of these cases brings out some interesting facts. The substances used for implantation include marble, glass, plaster (probably plaster-of-Paris), plaited silk, paraffin (with a melting point mentioned as either 62° or 55°, both probably referring to the Centigrade scale), vaseline, vulcanite, ivory (in the form of an esophageal bulb), India rubber, celluloid and silver. Paraffin, celluloid and silver seem to share the honors in the number of times employed. All the other materials mentioned seem to have the disadvantages of weight, disintegration, or infiltration by lime salts. According to Cartier, the prosthetic ball should not weigh less than 12 grains, for, if lighter, it is apt to be drawn toward or even into the inguinal canal by muscular contraction. Celluloid seems to be a satisfactory material if one can judge from a case kindly reported to me by Dr. Benjamin S. Abeshouse of Baltimore, in which a

celluloid ball had been implanted by another surgeon thirty-four years previously. On the other hand, I feel, from our knowledge of the non-irritating qualities of silver, that this is the best of all materials to use. Not only this, but the prosthetic silver ball can be made of any size, shape or weight.

Most of the cases reported have been followed for a sufficient length of time to know the results, both local and general, and it is noted that these implantations were unsuccessful in only a few. Where plaster, glass, marble or silk was used the implantation failed, and the mass had to be removed. In one case paraffin had been placed in the empty scrotum after orchidectomy for neoplasm. Nine months later it had to be removed together with masses of recurrent tumor which had invaded it. One patient is reported as being "dissatisfied" with his artificial organ, and had it removed later. Tuffier, hailed by Salles as the chief exponent of testicular prosthesis among French surgeons, apparently was not entirely optimistic about some of his own results. Although "the greater part" of them did well, many had pain, tenderness, or sinus formation. Reclus speaks of seeing a case of Tuffier's in which a large tumor had formed around the implanted testicle (which incidentally he believed to be of aluminum). Gelpi states that in his case, where an India rubber ball was implanted on either side because of bilateral cryptorchidism, not only were the two balls occupying a position close to the root of the penis, but also stitch abscesses and sinuses had occurred. From this it is seen that the prognosis, at least as to the local condition, must be somewhat guarded. It is important, however, to learn that in no case where celluloid or silver was used was there any untoward result.

Testicular prosthesis has been performed for a variety of reasons. In the earlier days, chiefly in the nineties, when bilateral castration was performed for the relief of prostatic obstruction, there was a demand for restoration to cosmetic perfection. Several cases were done after orchidectomy for tuberculosis, tumor, gonococcal or other infection. Many others demanded an artificial testicle to fill out the empty scrotum of cryptorchidism.

In many patients there was a very definite, sometimes profound, mental derangement occasioned by the half or completely empty scrotum. In all, however, it is to be noted that not only improvement, but, in fact, complete restoration of the normal mental status

came about in a short time after operation. I believe this is one of the important factors to be considered in these cases.

It is evident that successful prosthesis depends upon strict asepsis, absolute hemostasis, adequate drainage, selection of the proper material for the artificial organ, and finally the implantation of it when possible within the remaining tunical sac, rather than between other layers of the scrotum. It may, however, be difficult, perhaps impossible, to carry out this procedure in the presence of cryptorchidism, where there may be little or no tunical sac or even any development of the scrotal pouch. In Gelpi's case the two rubber balls lay close to the root of the penis, a position which certainly would interfere with appearances if not with comfort.

While obviously no question of diagnosis is apt to arise in the handling of a case requiring prosthetic surgery, it may be of interest to note that in one instance the surgeon, finding a firm and globular mass in the scrotum, suggested the advisability of an exploratory operation, having in mind a possible neoplasm. The patient then brought out a point in his history that had not been touched upon before, which was that the mass in question was a celluloid ball implanted there by another surgeon thirty-four years previously. He had derived satisfaction and comfort from it ever since.

Before reporting my case I wish to mention a few details of Hermance's case, apparently the first in which this operation was done. The patient was a man of twenty-one with unilateral cryptorchidism. Because of his desire to marry and being fearful of his sexual ability, he had gradually become seriously and profoundly deranged. For this reason Hermance suggested the idea of possible relief from a prosthetic testicle. First a model was made out of a piece of raw potato. This then was reproduced, apparently by a craftsman, in silver, but whether it was hollow or solid is not mentioned. The operation was a great success from every point of view. The patient soon recovered his mental equilibrium, married happily and became the father of children.

In my case I used a hollow silver ball, seven-eighths of an inch in diameter, of thin walls. Unfortunately it was not weighed. This was obtained from a jeweller friend by buying one of a pair of earrings. After cutting off the hook and polishing it the ball was ready for use. Inquiry shows that silver balls of this size,

which I think are rather too small, are made by manufacturing jewellers, and apparently cannot be obtained in larger sizes. I also find that any skilled silversmith could make such a ball of any required size, shape or weight.

The case I wish to report was referred to me in April, 1934, by Dr. Vernon Williams, a psychiatrist. The patient was a single, white man of twenty-nine, a musician by occupation, very intelligent and well educated. Five years previously he had been operated upon by another surgeon for what was evidently a congenital hernia with an

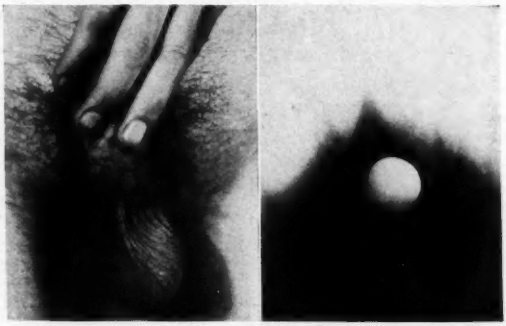

Fig. 1. *A*, Appearance of scrotum at this time with prosthetic testis in place. *B*, Roentgenogram showing the silver ball in the scrotum.

undescended and atrophic testicle. This testicle was removed. From that moment the patient had become more and more perturbed about the loss of the organ, until at times he was on the verge of suicide. Not only this, but whereas formerly he was athletic, a "good mixer," and an ardent lover, he found himself unable to join others socially, sexually, or in athletics. It was impossible for him to undress in a locker room before other men, as he was convinced that all eyes were focused upon the empty half of his scrotum. For a long time the idea of having an artificial testicle implanted had been his chief object in life, but he could not persuade any one of a number of surgeons to undertake the operation.

Finally he came to me, and I, feeling that there was more to gain than to lose, assented to the proposition. The patient was well developed, muscular and perfectly normal physically except for the empty scrotal sac on the right. The left testis and epididymis were normal.

Operation was performed on April 30, 1934, under gas-oxygen anesthesia. An incision 2 inches long was made through the anterior

scrotal wall. On dividing the subcutaneous tissues a layer was opened which separated easily by blunt dissection into a smooth-walled cavity which was probably the remains of the tunical sac. Into this cavity the silver ball was placed without difficulty. A very small rubber tissue drain was inserted, and the walls of the cavity closed with interrupted No. 00 chromic catgut. The skin was closed with subcutaneous silk. Convalescence was perfectly smooth, the drain being removed in seventy-two hours, the skin stitch on the sixth day. The patient was discharged on the eighth day. At no time has there been the least pain, redness, swelling, tenderness, or evidences of irritation. The tissues overlying the ball show no evidences of tension. I have seen the patient recently and on several other occasions since operation. As will be seen in the accompanying illustration (Fig. 1) the ball hangs quite normally, and except for its size one would be unable to say whether it is real or artificial. The most striking thing is the change in the patient's mental condition. He is a cheerful, happy, optimistic individual who has returned with even increased enthusiasm to his former pursuits, social, athletic and amorous. He proudly states that no one could possibly tell what he had had done. I feel that a result like this is quite worth while.

BIBLIOGRAPHY

ABESHOUSE, BENJAMIN S.: Personal communication.
BURMEISTER: Artzliche Rundschau, 12: 1902.
CHASSAIGNAC: Discussion, cf. Gelpi.
DEMONS: Cited by Salles.
GELPI: New Orleans Med. and Surg. Jour., 70:355, (Oct.) 1917.
GUELLIOT: Union Mèd. du Nord-Est, Reims, 19: 1895.
GUINARD: Bull. et Mem. Soc. de chir. de Paris, N. S., 29: 1903.
GUITERAS: American Medico-Surg. Bull., (May) 1894.
HERMANCE: Am. Jour. Insan., Chicago, 51: 1894-5.
HUMBERT: Cited by Salles.
LEXER: Deut. med. Wchnsch., 30: Ver.-Beil, 43, 1904.
RECLUS: Discussion, cf. Guinard.
REYNIER: Discussion, cf. Guinard.
SALLES: De la Prosthèse Testiculaire, Thèse de Bordeaux, 1896.
TUFFIER: Discussion, cf. Guinard.
TRAUTER: Hosp.-Tid., Copenhagen, 4 R., 10: 1902.
WEIR: Med. Record, (Aug. 11) 1894.
WEIR: Trans. Amer. Surg. Assn., 13: 1895.

DISCUSSION

DR. J. A. C. COLSTON (Baltimore, Md.): In connection with Dr. Barney's paper, I should like to cite a case which is not similar to his except in the psychic reaction which occurred. The individual in question was a cook on a Swedish tramp steamer, aged about thirty-five. He had a very typical Fröhlich's syndrome. He had, of course, a female voice and female configuration of the body, no beard, and a marked under-development of the external genitalia. In the scrotum, which was very poorly developed, one could feel just two tiny nubbins perhaps of testicular tissue. He wanted something done.

At this time we happened to have a postgraduate student, a very enterprising man who was interne in the Maryland Penitentiary in addition to doing postgraduate work with us. We all discussed the fact that we would like to make a glandular transplantation. He immediately suggested that among the guests in the Maryland Penitentiary there was a young colored man who was about to receive from the majesty of the law his final lesson, and he suggested the possibility of a transplantation from the material which would be available. We were naturally terrified to do this on account of the fact that newspapers might get hold of it, but at any rate we decided to carry it out with as much secrecy as possible. I think there is a law in the State of Maryland that an autopsy has to be performed on executed criminals. After the ceremony, which took place at dawn and which I did not attend, it was the duty of the interne to perform the autopsy. So under surgical technic he did at the start of the autopsy a double orchidectomy. We were waiting over in the hospital with the Swedish cook.

I might say about the Swedish cook that I will leave it to your imagination the vicissitudes to which he was subjected during his services as cook on a tramp steamer. He was of low mentality.

At any rate, our postgraduate arrived with this material from the penitentiary, which was most impressive. We decided to do two things. One was to take one testicle and slice it as thin as possible and plant slices in a long incision in the rectus muscle; secondly to transplant the other testicle completely in the scrotum

without any blood attachment and see what would happen. We knew, of course, that it would necrose, but we thought possibly some of it might live. That operation was carried out. We made a long incision and we had plenty of slices of this material. There was enough to go the whole length of the rectus. The other testicle was transplanted into a pouch in the scrotum. It is interesting that we thought the scrotal wound would probably break down because there would certainly be a necrotic mass of tissue, but that incision held. The testicle mass remained without any sign of inflammatory reaction, but, of course, it gradually disappeared.

The ultimate result was entirely psychic in this individual. There was no change in his voice or his sexual characteristics. I think possibly we rather expected that, because he was thirty-five years old when we started. The incision in his rectus muscle healed nicely. However, there was very marked psychic effect in that after his next voyage he reported a great many adventures that he had during his short leave in Sweden, which I think we all took with several grains of salt, but at any rate as far as his psychic condition was concerned, there was a very marked improvement and he was really a different individual. As for any result he got from the testicular hormone which we hoped might be evident, the operation was not successful.

DR. VINCENT J. O'CONOR (Chicago, Ill.): In regard to the transplantation of foreign bodies into the scrotum, I should like to mention a patient who was brought into the hospital this winter and died very promptly following massive hemorrhage from a gastric ulcer. He had a history of having had a right inguinal hernia repaired three years previously in our own hospital. Ten years prior to his fatal admission he had had an inguinal hernia repaired by one of our most outstanding surgeons in Chicago. No notation was made on the history record three years prior to his death, either from history or physical examination point of view, of anything amiss in the scrotal region, yet the patient was examined by the internist, a clerk. and the attending man. At autopsy the pathologist, in removing the genital organs, felt the left testicle to be somewhat unusual and in removing the testicles uncovered what appeared to be the left testicle covered by a thick fibrous sheath at least a quarter of an inch thick. I have the specimen and

the manner in which this foreign body was encapsulated was quite unusual. There was a very light glass ball, which presumably had been implanted in the left scrotum, apparently at the time of the first hernia operation.

The interesting thing about this glass ball was that it was the type of glass ball that Buffalo Bill and Annie Oakley used to shoot at in midair. It has hardly any weight at all, is very buoyant looking and the glass looks very thin. Another interesting thing was that this transplantation was so well done that no one suspected the presence of a glass ball in place of the left testis. Reparative processes took care of putting a very heavy layer of fibrous tissue around this foreign body as a protective mechanism.

DR. FRANCIS R. HAGNER (Washington, D. C.): Some years ago I intended to use a ping pong ball for one of these cosmetic cases, but I found a little rock on my way to the hospital that had a beautiful shape, like an olive, so when I got to the hospital I put it in this gentleman's scrotum. It was there six years afterward. It, however, had moved back a little toward the perineum, but it was still in place.

SOME OBSERVATIONS ON FEMALE UROLOGY

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The close proximity of the female generative and urinary tracts and the frequency of associated pathology is often responsible for confusion in diagnosis and occasionally for errors in treatment. These are especially prone to occur in the presence of those conditions of the reproductive and urinary organs which are accompanied by symptoms suggestive of lesions in one or more organs of the opposite group. In a recent study of 425 female patients with urinary disturbances the etiologic factor was found in the urinary organs in 328 (77 per cent), in the generative organs in ninety (21.1 per cent) and in other locations in seven (1.9 per cent). Combining these 425 with 1,052 additional cases studied at various times it was found that pathologic conditions of the urinary organs were responsible for the symptoms in approximately 1,115 (75.4 per cent) and the generative organs in about 362 (24.5 per cent).

The most common lesions of the female urinary tract in the order of the frequency of their occurrence were: urethritis, usually associated with trigonitis, strictures of the urethra, cystitis, pyelonephritis, ureteral strictures and hydronephrosis. The conditions most often responsible for mistakes or uncertainty in diagnosis were urethral strictures, pyelonephritis, ectopic kidneys, ureteral calculi and ureteral strictures. The principal symptoms of which these patients complained were frequent urination, local or referred pain, burning and dysuria.

The most common lesions of the generative organs with symptoms suggestive of urinary tract pathology were cervicitis, salpingitis, vaginitis and fibromyoma uteri. The usual symptoms in these cases were frequent urination, pain and burning.

RENAL ECTOPIA

The manifestations of ectopic kidneys are quite common in women. The following brief reports are of interest especially from the standpoint of differential diagnosis.

Case 1.—A married woman, forty-six years of age, complained of pain in the left lower abdominal quadrant, backache and vaginal discharge. Examination revealed a mass in the left lower quadrant, tenderness in both lower quadrants and infection in Skene's glands.

Provisional diagnosis: Pelvic inflammatory disease and possible tumor of the uterus. Excretory urography, however, revealed an ectopic left kidney (Fig. 1*A*). A cystogram (Fig. 1*B*) showed that the upper anterior portion of the bladder was pressed forward by this

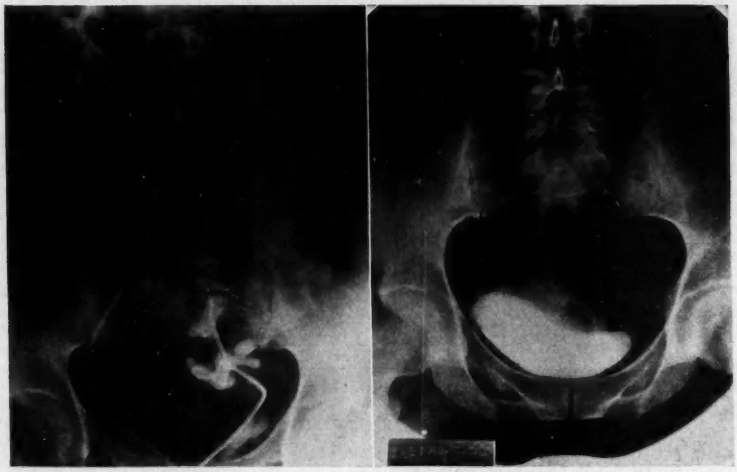

Fig. 1a *(left)*. Ectopic left kidney. Provisional diagnosis: Pelvic inflammatory disease or tumor of the uterus.
Fig. 1b *(right)*. Bladder pressed downward and forward by an ectopic left kidney.

organ. Although no ureteral stricture could be demonstrated, all symptoms disappeared following dilatation of the left ureter and a slight stricture of the urethra.

Case 2.—A married woman, twenty-eight years of age, complained of frequent urination, pain and a mass in the left lower abdominal quadrant of ten years' duration. The mass had gradually increased in size. The urine contained a few pus cells. A diagnosis of fibroid uterus was made and hysterectomy advised. Pyelography, however, revealed an ectopic left kidney (Fig. 2).

Case 3.—Mrs. F. complained of a lump in her abdomen and weakness of one year's duration. She had lost 20 pounds during that period. The mass appeared to lie in the lower abdominal cavity just

under the anterior wall. An abdominal mass with a rather large irregular calcification in its center was vaguely outlined on roentgenography (Fig. 3). Plain roentgenograms showed apparently normal kidney shadows although the right was poorly defined. The preliminary diagnosis was a calcified hemorrhage or a dermoid cyst with bone formation. The possibility of a tumor of the right Fallopian tube, an omental cyst or hydrops of the gall bladder was also considered. Excretory urography revealed a normal kidney pelvis on the left side;

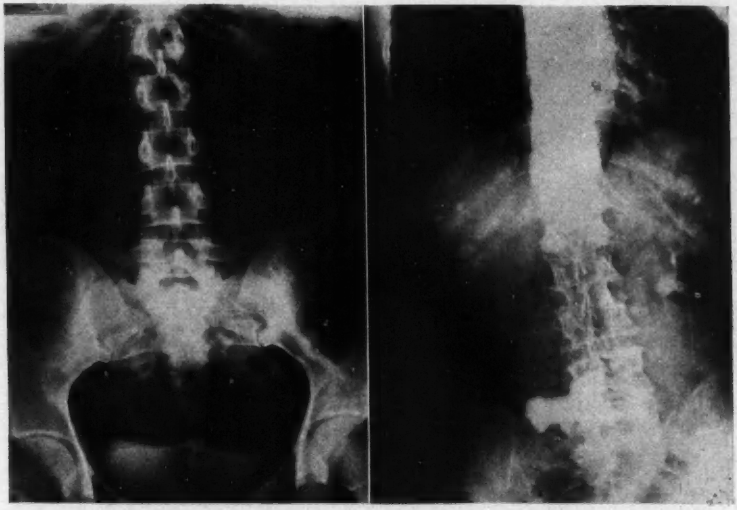

Fig. 2 *(left)*. Ectopic left kidney mistaken for a fibroid tumor of the uterus.
Fig. 3 *(right)*. Ectopic right kidney with large calculus and numerous cysts. Diagnosis uncertain preceding excretory urography.

none was seen on the right. A large ectopic right kidney lying crosswise at the brim of the pelvis and containing a stag-horn calculus was found at operation. The renal parenchyma contained numerous communicating cysts and was almost completely destroyed. The shadow of the liver was mistaken at the first examination for that of the right kidney.

Case 4.—A married woman, twenty-two years of age, complained of frequent urination, nocturia and pain in the right lower abdominal quadrant radiating toward the right lumbar region. Roentgenography showed low rotated kidneys (Fig. 4) with the lower poles pointing toward the midline, undoubtedly a horseshoe kidney. Additional uro-

logic investigation gave no information of importance. The characteristic pain was reproduced by pressure on the right adnexa during vaginal palpation. All symptoms disappeared following bilateral salpingectomy and right ovarectomy.

Case 5.—Mrs. B. complained of frequent urination, dysuria, pain in the right lower quadrant and lumbar backache. She had been treated elsewhere for pyelitis. Urography showed a double kidney on the right side. The urine contained a few pus cells. A cystogram

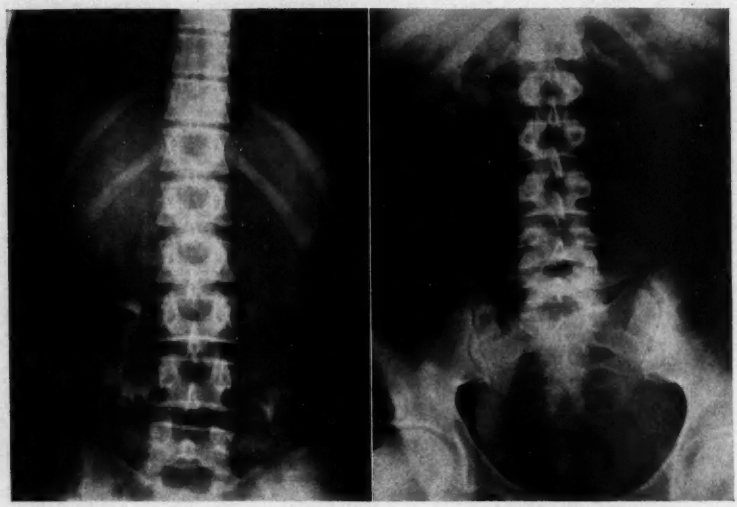

Fig. 4 *(left)*. Horseshoe kidney. Urinary symptoms due to pelvic inflammatory disease.

Fig. 5 *(right)*. Cystogram showing marked lateral compression of the bladder by a large cyst of the left ovary.

showed a marked lateral compression of the bladder wall (Fig. 5). All symptoms disappeared following the removal of a large cyst of the left ovary.

CYSTITIS

Cystitis, the most common pathologic condition of the female bladder, is a symptom rather than an independent lesion in the majority of instances. In a former study of 102 cases of cystitis the etiologic factor or factors were apparently located in one or both kidneys in fifty-five, in the urethra in thirty-seven, in both the kid-

neys and urethra in six, confined to the bladder in three and outside of the urinary tract in one. Cystitis was more frequently associated with urethral obstruction in these cases than with cervicitis or other generative or urinary tract pathology. It usually responded promptly to urethral dilatation in the absence of upper tract infection.

URETHRITIS

The frequency and importance of various pathologic conditions of the female urethra is gradually receiving a long deserved recognition. In the 425 patients with urinary disturbances previously mentioned urethral lesions were found in 328. Urethritis and strictures comprised the majority of these cases. The fact is not generally appreciated that non-specific urethritis and both congenital and acquired urethral strictures are common in women.

Urethritis was found in 150 of this series of 425 patients. Some cases with concomitant strictures were probably not detected because of the impracticability of satisfactory urethroscopic examination in the presence of urethral obstruction. Persistence of urethritis is usually due to infection of the urethral glands. Some authors deny the presence of glands in the female urethra other than the para-urethral glands, sinuses or lacunæ, of which Skene's are the best example. They claim that the other structures which may resemble glands are simply inclusions of the epithelium, the "cell nests" of Brun which have undergone liquefaction with the formation of unilocular gland-like structures. Robin and Cadiat[5] in 1874 and more recently Johnson,[3] Sachs,[6] Renner,[4] Folsum,[2] and others have, however, demonstrated peri-urethral glands in this sex. It has been conclusively proven that the female urethra contains glands which, although less highly developed, correspond morphologically and in their arrangement to those of the male prostate gland. Prostatic concretions originally described by Morgagni and Virchow[8] were found in several of Renner's cases.

URETHRAL STRICTURE

Sixteen years ago, impressed by the frequency with which improvement often followed a single cystoscopy, I decided to calibrate the urethra of every patient with symptoms suggestive of urinary tract pathology. The results of this routine procedure

since that time have confirmed the opinion expressed in a paper read before the California Medical Association in 1919 that, contrary to textbooks, an abnormal narrowing, in other words a stricture, of the female urethra, is a common condition.

In the recent series of 425 patients with urinary symptoms urethral strictures were found in 174 (41 per cent). In a former series of 633 cases urethral strictures were found in 190 (30 per cent) and in still another group of 169 cases strictures were found in ninety-four (55.4 per cent). In the total of 1,227 patients with urinary symptoms I found strictures in 458 (37 per cent).

Strictures may either be congenital or acquired. The latter are subdivided into inflammatory and traumatic, gonorrhea or other infections of the urethra being the most common etiologic factor in the former and childbirth or cauterization of the urethral glands and growths in the traumatic type. It would seem advisable to calibrate the urethra after difficult confinements and following fulguration or cauterization. I believe that in those cases due to foci of infection not located in the upper urinary tract, the cervix and other female pelvic organs are more often responsible for urethral pathologic changes than the teeth, tonsils and other more remote structures.

Spasmodic strictures, caused by involuntary contraction of the urethral musculature, are occasionally found in hypersensitive women. I have seen four cases, all of which were more or less resistant to treatment.

So-called symptomatic strictures are not uncommon in the adult female. The following case illustrates this type:

A single woman, forty-five years of age, complained of complete retention of urine of three days' duration. She had always suffered from frequency and nocturia. The latter had increased in severity during the past few weeks. She had also had a "pulling" sensation in the right abdominal quadrant for one week. During the four days previous to the onset of complete retention she had voided small amounts of urine with difficulty. Purulent urine (1,500 c.c.) was withdrawn on catheterization. A large pelvic mass, probably a fibroid uterus, was found on vaginal examination. The urethra was pressed to the right. A cystoscope was introduced with difficulty because of obstruction caused by the pressure of the mass on the urethra. The bladder was markedly injected and hypertrophied. All symptoms disappeared following hysterectomy.

Urethral strictures are most frequently found at the external meatus. A thin ring or circular band of tissue resembling a partial diaphragm is often seen at this location on withdrawal of a bulb bougie. In the majority of congenital strictures the meatus is of this type. In other cases an increase in fibrous connective tissue or cicatricial contraction will be observed. Strictures were located at the external meatus only in 149 cases; in the anterior third of the

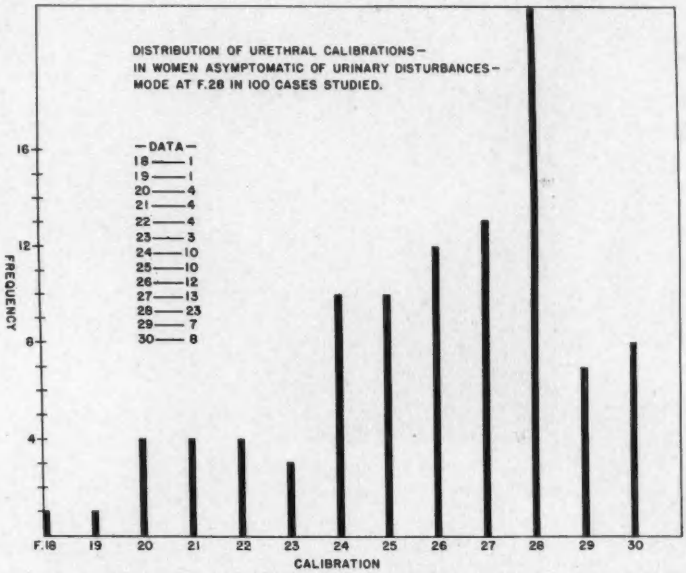

Fig. 6. Urethral calibration in 100 adult female patients who had never complained of symptoms suggestive of pathologic disturbances in the urinary tract.

urethra in thirteen, in one of which a stricture was also found at the external meatus; in the posterior third including the internal meatus in eight, in one of which a stricture was also found at the external meatus, and in the middle third in four, in one of which a stricture was also found at the external meatus. The average size of the 174 strictures was F. 21.5.

We have calibrated the urethras of 118 women who had never

suffered from symptoms suggestive of pathologic changes in the urinary tract. These showed an average size of F. 26. The smallest was F. 18 and the largest F. 30. Olive tip bougies with the French scale of measurement were used exclusively in this work. I believe that a urethra below F. 26 is very often responsible for symptoms and pathologic conditions such as persistent chronic infection in both the urethra and upper urinary tract.

The most common pathologic conditions of the urinary organs associated with urethral strictures were urethritis and trigonitis, cystitis and renal infection. Congenital obstructions of the urethra

Fig. 7. Demonstration of the bend in the upper part of the normal female urethra.

are probably important factors in the cystitis and pyelitis so common in female infants and children. Whereas kidney infection was associated with urethritis in but five of 150 cases, it was present in seventeen of the 174 cases with urethral stricture. Eighteen of the patients with urethral strictures also had a concomitant cystitis. This usually disappeared rapidly, following meatotomy or dilatation of the urethra in the absence of renal infection. One patient was referred to our clinic with a diagnosis of appendicitis. All symptoms disappeared following meatotomy.

Urethral obstruction is due in a very small number of cases to polypoid formation or to a thickening in the posterior urethra with or without contraction of the vesical orifice, the so-called pros-

tatism in the female. These conditions are usually due to a low grade infection of many years' standing.

While dilatation of strictures at the external meatus will usually result in the relief of symptoms, meatotomy is the procedure of choice for obstructions at this location. It is preferable to bring the skin and membrane together on both sides of the meatus with fine catgut following incision. This will result in less postoperative bleeding and prompt healing. Further passage of dilators is seldom necessary following this procedure. Strictures in the canal yield readily to gradual dilatation. It is occasionally necessary to fulgurate obstructions at the vesical orifice. Resection may occa-

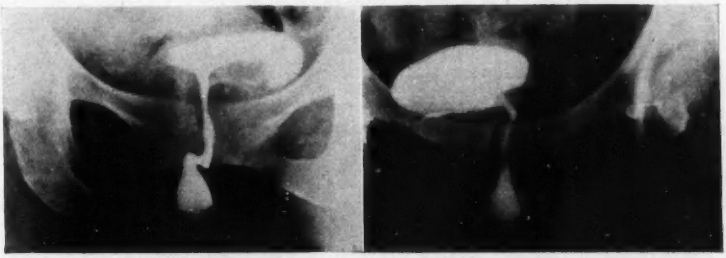

Fig. 8 *(left)*. Ventrodorsal view of the normal female urethra showing the narrowing just posterior to its middle third.

Fig. 9 *(right)*. Normal bend but relative incontinence of urine probably due to a central nerve lesion.

sionally be required. Ninety-five per cent of our patients showed marked improvement, the majority apparently being cured; 5 per cent were unimproved.

URETHROGRAPHY

It has been necessary to change our conception of the anatomy of the female urethra since Einar Thomsen's[7] roentgenographic studies of this organ. This author has demonstrated an angular bend in the posterior urethra at the point where it is suspended in the loop formed by the sphincter trigonalis and Heiss's muscle fibers. Thomsen states that a straightening out of this bend will result in incontinence of urine. I have found exceptions to this rule. The conclusions may be drawn from Thomsen's investigations, however, that an operation to tighten or support the anterior wall

of the urethra may be necessary in some cases of incontinence. Thomsen has also shown the narrowing at or just above the middle portion of the urethra corresponding to the point where it passes through the urogenital diaphragm. A slight resistance is

Fig. 10 *(left)*. Distortion of the urethra by a growth involving the posterior third of the urethra, vesical orifice and trigone.

Fig. 11 *(right)*. Urethral pockets due to a stricture at the external meatus.

sometimes encountered at this location on instrumentation. It should not be mistaken for a stricture.

The accompanying urethrograms are of interest in connection with this subject (Figs. 6–11).

SUMMARY

Ectopic kidneys are not uncommon in women. They are sometimes responsible for symptoms suggestive of pathologic changes in the generative tract.

Pyelography is of more value than any other single procedure in the differential diagnosis of pathologic conditions of the female generative and urinary organs.

Urethral strictures are common in women. The majority are located at the external meatus and may be congenital or acquired. They are frequently responsible for pathologic changes in the upper urinary tract and for a large variety of subjective symptoms, including pain in various locations.

The average size of the normal urethra in the adult female is F. 26. The average size of urethral strictures is F. 21.

Our urethrograms show the angular bend and narrowing in

normal female urethras as recently demonstrated by Einar Thomsen.

Urethrography is a valuable diagnostic procedure. It is frequently indicated in the presence of symptoms suggestive of pathologic changes in the urinary tract in this sex.

BIBLIOGRAPHY

1. Crane: Calif. and West. Med., 33:572-575, (August) 1930.
2. Folsom, A. I.: Jour. A. M. A., 1345-1350, (Nov. 7) 1931.
3. Johnson, Franklin P.: Jour. Urol., 8:1, 1922.
4. Renner, M. J.: Surg., Gynec. and Obstet., 52:1087-1092, 1931.
5. Robin, Ch., and Cadiat: Jour. de l'anat. et de la physiol. Paris, 10:514-557, 1874.
6. Sachs, O.: Wien. klin. Wchnschr., vol. 24.
7. Thomsen, Einar: Acta Radiologica, Vol. 11, 1930, and Vol. 12-13, 1931-1932.
8. Virchow, R.: Arch. of path. Anat., 5:403-404, 1853.

DISCUSSION

DR. ROGER C. GRAVES (Boston, Mass.): In connection with Dr. Stevens' paper and the confusion that often arises between the lesions of the genital tract and the urinary tract in women, I wish to cite a case that I have seen within the last month. The patient was a woman of forty who some months before had been given a diagnosis of pregnancy because of a palpable pelvic tumor and a positive Aschheim-Zondek test. Her symptoms were predominantly bladder symptoms. She was not at all relieved by the diagnosis of pregnancy, and so came to Boston where I saw her in urologic consultation. The cystoscopic appearance of her bladder was extremely interesting. It was perfectly normal except that protruding through the posterior wall was a sort of horn of tissue much of the size and shape of my finger, literally sticking right through an otherwise normal bladder wall except for a little fixation and edema around its base. The distal portion of this protruding horn had become devitalized and was sloughing. There was no ulceration.

On the basis of a tumor which I could feel in the pelvis back of the bladder and the positive Aschheim-Zondek test, I told the physician that I thought that the patient had a tumor of the ovary, which was growing by direction extension through the bladder wall and suggested that she be referred to a gynecologist. This was done and a diagnosis of endometriosis was made, although the cystoscopic picture which I have described would hardly be expected in this condition. The patient was operated upon and a tumor of the ovary was found. It proved to be a papillary mucinous type of ovarian tumor, not very malignant, but it had grown through the bladder wall, and it had also invaded the wall of the sigmoid.

In talking about it later with Dr. Warren, the pathologist, he told me that when the patient had come into the hospital the urine had shown on one occasion a specific gravity of 1.058, and that if this had been taken into consideration it might have been helpful in arriving at the correct diagnosis. He said that he knew of nothing except mucin that would give a specific gravity of 1.058.

If so, that is worth remembering. I have had no chance to look into it further, but I give it to you for what it may be worth.

The positive Aschheim-Zondek test, of course, must have been read in error, because this tumor would not be expected to give a positive Aschheim-Zondek reaction.

DR. E. G. CRABTREE (Boston, Mass.): I want to speak briefly regarding the use of the urethrogram in the female. There is undoubtedly frequency of occurrence of strictures, as indicated by Dr. Stevens' paper, but there are a great many other things that the urethrogram will show which I think are very difficult to show by cystoscopy. To those of you who attend the San Francisco meeting I hope to demonstrate some of the relations of the urethra to the bladder in straining and relaxation. Apparently the urethra can lose its attachment and undergo great changes which have some bearing on the poor results obtained by certain types of gynecologic operations.

In addition to the demonstration of pathologic changes of the urethra which I think can be better shown by the urethrogram than by the cystoscope, it also brings out some of the unlooked for, accidentally produced lesions, the result of gynecologic operations, such as acute angular plications, plications that miss the sphincter and are way out on the urethra, and the artificially produced stricture that comes from these manipulations. I think it is fair to say after three years of observation that we are relying more upon the urethrogram in the female than we are upon the cystoscope for demonstration of the nature of its lesion.

DR. CLYDE L. DEMING (New Haven, Conn.): In the consideration of those normal urethras was there any marked difference between the married and the unmarried woman as far as the calibration was concerned?

DR. STEVENS: There was very little difference between the urethra in the woman who had never suffered from urinary symptoms and the woman who had.

INTRATHECAL INJECTIONS OF ABSOLUTE ALCOHOL FOR THE RELIEF OF INTRACTABLE PAIN

CHARLES M. McKENNA, M.D., and ERIC OLDBERG, M.D.

Chicago, Illinois

This procedure was first proposed by Dogliotti, who in October, 1931, in the *Revue Neurologique* published a series of cases in which he had performed such injections. Several subsequent reports from other authors have been published and the procedure is now in the stage of being fairly well accepted generally.

Technic.—The patient is placed on his side and a careful lumbar puncture is performed at the first lumbar interspace. When the end of the needle is known to be in the subarachnoid space and not in contact with the conus medullaris and upper part of the cauda equina, which lie in that region, 1 to 1.5 c.c. of absolute alcohol is slowly injected. Some stop injection at this point, while others inject until the patient experiences sensations of tingling in the lower extremities. We do not believe, however, that anyone uses more than 2 c.c. under any circumstances.

The side of the patient on which the pain is most severe is usually placed uppermost, since the alcohol will rise in the cerebrospinal fluid. The patient is then left in this position for about ten minutes, after which he may be placed on his back.

For about a week following such an injection there is usually a slight increase in cerebrospinal fluid pressure and some increase in cell count. This, however, disappears at the end of that time so that a second injection can be performed, if necessary.

DISCUSSION

The procedure of alcohol injection is a valuable addition to the armamentarium for the treatment of intractable pain. Heretofore, excessively painful lesions of the genito-urinary and pelvic organs and of the lower extremities have necessarily been treated either by medication, a distressing situation when addiction occurs, or by operation. The operations of choice have been either denervating procedures, or have involved cutting the tracts in the

spinal cord which convey the sensations of pain, namely, chordotomy. Both of these operative methods, needless to say, have involved some risk, both as to life and as to normal neurologic function.

Alcohol injections, on the other hand, seem to entail little or no immediate risk if properly performed. Patients who have submitted to this procedure may complain of slight weakness in the extremities for a few days accompanied by some vague paresthesia, and in a few instances they may also complain of difficulty in sphincter control. These factors, however, are transitory and it is customary not to be able to elicit a single objective neurologic sign within a few days after injection. In addition to this, there is no impairment of the ejaculatory reflex, as there is after both chordotomy and bladder denervation operations.

There is one feature of intrathecal alcohol injection which has not, as yet, stood the test of time, and that is, the danger of a chronic inflammatory reaction which may eventually lead to such complications as the production of root pain. Another limitation of alcohol injection is that its use must be confined to pain originating in the lower half of the body, although a few authors have reported attempting it for pain situated in the upper part of the trunk and the upper extremities.

A conservative evaluation of this procedure could be stated as follows: It is an extremely valuable method of relieving intractable pain, which is apparently efficacious, at least temporarily, in a high percentage of cases. For patients in whom life expectancy is short and whose physical condition or age makes an operation like chordotomy inadvisable, it should always be tried, at least as a preliminary measure. For patients in good physical condition, with a reasonably long life expectancy, other factors must be taken into consideration. Certainly, for any patient who wishes to retain his ejaculatory reflex, it should be tried. It is also a valuable alternative for those persons who dread operation, or in whom the production of a permanent hypalgesia would be inadvisable for psychic reasons. It should be remembered, however, that in those individuals with a comparatively long life expectancy there may be subsequent though long delayed ill effects from irritation by the alcohol. For this reason it is not advisable to repeat the injection more than once, and to be circumspect in the choice of cases.

CASE REPORTS

Case 1.—Mr. A. S., aged seventy-four, by occupation a carpenter, entered the hospital December 5, 1934, with an acute retention and a markedly hypertrophied prostate. A diagnosis was made of carcinoma of the prostate and a transurethral resection was done on December 17. On February 1, 1935, the patient re-entered the hospital, complaining of severe pain in his left leg, resulting in inability to sleep well and necessitating narcotics for relief. Examination at this time revealed no new findings. Neurologic examination disclosed the absence of ankle and patellar reflexes on the left side. A diagnosis was made of an infiltrating carcinoma from the prostate. On February 4, 0.5 c.c. of absolute alcohol was injected intrathecally into the spinal canal. The patient continued to complain of some pain following the injection, though aspirin and pyramidon controlled it. One week later, 1 c.c. of alcohol was injected because the pain had returned. This relieved the pain entirely and the patient was discharged from the hospital with instructions to use aspirin. Two months later he was re-examined. He was unable to move his left leg well, though he had no complaint of pain.

Case 2.—Mrs. A. L., aged forty-two, a housewife, entered the hospital May 13, 1935, complaining of nocturia ten to fifteen times and a frequency of every fifteen minutes during the day. She had been in the hospital previously and at that time her condition was diagnosed as a bilateral renal tuberculosis. At this entrance, the patient complained of severe pain causing the marked frequency. On May 18, 1 c.c. of absolute alcohol was injected intrathecally, and following this she had a nocturia of only two to three times, with a frequency of about eight times during the day. She was discharged from the hospital, and as yet no further observations have been made.

Case 3.—Mr. R. B., a student, aged twenty, entered the hospital March 14, 1935, complaining of marked frequency of every ten minutes during the day and approximately every half-hour during the night. This was so irritating to the patient that he was losing a large amount of weight. He gave a history of having had a right nephrectomy, bilateral epididymectomy, and numerous other genito-urinary procedures during the five preceding years. He was given an intrathecal injection of alcohol on the day of entrance. This gave him marked relief from the pain and decreased the frequency to two-hour intervals during the day, and three-hour intervals at night.

Case 4.—Mrs. A. S., a housewife, aged thirty-eight, entered the hospital March 23, 1935, complaining of pain in the right side, frequency of every twenty minutes day and night, and dysuria, all of two years' duration. She also gave a history of nephrectomy at some other hospital for tuberculosis of the kidney one year previously. At the

present time Koch's bacillus was found in the urine, and a diagnosis was made of a tuberculous infection in the remaining kidney together with tuberculous cystitis. Intrathecal injection of alcohol was done on April 11, 1 c.c. of absolute alcohol being used. Following the injection the patient developed marked retention, necessitating catheterization for twenty-four hours. The frequency diminished to three-hour intervals and there was no complaint of pain that could not be controlled by aspirin.

Case 5.—Mr. J. C., aged fifty-eight, a railroad machinist, entered the hospital February 22, 1935, complaining of severe pain in the rectum, with the history of having had a Kraske operation, at which time a microscopic diagnosis was made of adenocarcinoma of the rectum. He was given an alcohol injection of 1 c.c. intrathecally in a previous hospital admission, with some relief of the pain, but not complete relief. A second injection was given on February 22, 1935, following which he developed a retention, necessitating catheterization for forty-eight hours, with some weakness of the left lower extremity. He had slightly diminished muscle power, though when he was discharged three days later, he was walking and had no complaint of pain. This patient was not observed further.

Case 6.—Mr. C. C., aged fifty-six, an auto mechanic, entered the hospital February 23, 1935. He had had a Kraske operation performed on June 18, 1934, with an uneventful recovery. The diagnosis was carcinoma of the rectum. At the present time he complains of severe pain in his rectum upon walking. It is relieved by sitting down. The pain is sharp, shooting in character, lasting for short intervals, and during the interim is of a dull aching character. On February 23, 1 c.c. of absolute alcohol was injected intrathecally, which gave him some relief from pain, though he still complained of an occasional sharp pain in the rectum. On March 1 the injection was repeated, following which there was a complete absence of pain sensation. He was discharged from the hospital the following day. He was observed the last week of May, at which time he had no complaint of pain.

Case 7.—Mr. J. U., aged fifty-nine, a crane operator, entered the hospital December 7, 1934. He gave a history of previous hospitalization, at which time a colostomy was done and a biopsy of the mass in the lower rectum showed an inoperable adenocarcinoma. The patient received several courses of radium treatment, and he entered the hospital complaining of severe pain in the rectum and left leg, so that he was unable to sleep nights. He gave a history of a recent loss of weight and was markedly emaciated. He was given an injection of absolute alcohol, following which he had complete relief from pain for the two weeks he was under observation.

Case 8.—Mr. G. K., aged thirty-seven, a painter, entered the hos-

pital December 11, 1934, complaining of pain in the rectum of eight months' duration. He gave a history of a colostomy performed at the Cook County Hospital in February, 1934. At that time a diagnosis was made of adenocarcinoma of the rectum, and no further treatment was given. For the following eight months he received a large amount of narcotics for the relief of the pain and on December 15, 1 c.c. of absolute alcohol was injected intrathecally. He received some relief from the pain, though the true value of the injection is doubtful because of his addiction.

DISCUSSION

Dr. William C. Quinby (Boston, Mass.): I wish to express my personal regret that Dr. McKenna is not here or that Dr. Oldberg was not able to come in his place.

Intrathecal injection of alcohol bids fair to become a very important procedure in fighting the very severe pain such as accompanies secondary malignant deposits from cancer of the bladder, prostate, or uterus. Another method of interrupting pain sensation is by chordotomy. Chordotomy, of course, is an extensive and difficult operation. The aim of the operation is to cut the pain fibers in the antero-lateral tracts of the spinal cord. The estimate of just how deeply into the cord the knife should go is not too exact. On the whole, although Dr. Grant of Philadelphia has had excellent results, chordotomy at the hands of most is an uncertain operation. Certainly the intrathecal injection of alcohol, if it will come anywhere near giving the results previously obtained by chordotomy, is a distinct step in advance. In a number of our patients during this last year suffering from uncontrollable pain, alcohol has been injected into the spinal canal with excellent results. Absolute alcohol is used in small amount. Two cubic centimeters is probably an average dose. The patient is kept for three hours in such position that the alcohol will bathe the nerve fibers which are involved. The position of the patient may be prone or in the kidney position, in order to get the alcohol to rise to the side on which pain is experienced.

At present we have a patient who has generalized malignancy due to a radio-resistant testicular tumor, and whose pain is perfectly frightful. I saw this patient, on leaving to come here, entirely relieved following such injections. Even though the relief be transient, lasting only a month or so, it is a procedure quite worth while.

Dr. Benjamin S. Barringer (New York City): May I ask you how you place the position of the patient for various lesions?

Dr. Quinby: The patient must remain in the position that you choose for him about three hours, so it is usually done on an oper-

ating table, and with cushions, the elevator, et cetera. The patient is put either in a marked kidney position, with the side up, or he is placed more prone according to where the pain is. There is no single position. It is a matter of getting the side of the lesion uppermost and getting the head as far down as possible, so that there will be no tendency for the alcohol to go other than where you put it.

DR. GEORGE R. LIVERMORE (Memphis, Tenn.): Do you use the alcohol pure without diluting, or do you withdraw any of the fluid to mix with it when you inject it? Do you inject it very slowly?

DR. QUINBY: Have the alcohol absolute. I mean it must be recently made absolute alcohol. It is not diluted.

DR. EDWARD L. KEYES (New York City): Have you repeated injections? We have used the injection once on several patients and it seems to relieve them, as you say, for about a month or so. Do you know, either of your own knowledge or from other information, the effects deleterious or otherwise of repeated injections?

DR. QUINBY: It is just as effective the second time.

DR. IRA SISK (Madison, Wis.): I would like to point out that this procedure is not without danger. Of course, if one uses it in malignant disease only, it doesn't matter so much. For the last year I have had under treatment a woman who had this injection for pelvic pain which was not due to malignancy. Immediately after injection she developed complete retention of urine which persisted for two or three months. Then she developed the usual infection in the bladder and in the kidneys. This progressed to a total destruction of the right kidney and to serious impairment of function of the left kidney. For the last six months she has been wearing a nephrostomy tube in the left kidney. The injection was made more than a year ago and she has not yet regained the ability to empty her bladder. However, she has not had a recurrence of her pain.

A FURTHER REPORT ON THE CURE OF HYPOSPADIAS AND EPISPADIAS

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In 1931 I talked before this society on the "Surgery of Hypospadias and Epispadias," and at that time presented a comprehensive review of the literature together with my personal ideas as to the cure of these conditions. It is because I believe that I am able from further study and observation to add to this subject that I have chosen to talk on it today.

Four years ago the surgery of these conditions was in a most unsatisfactory state. Because of the confusion that existed, very serious papers were published on transplantation of the appendix to the penis for the formation of the urethra. I doubt if anyone today would consider this type of graft. Further, occupying an equal plane, and all seemed to be about equal, was the free skin graft of Nové-Josserand, the advancement of the urethra operation of Beck, the transplantation of the appendix of Lexer, the transplantation of the ureter of Schmieden, the transplantation of a vein of Tanton, together with innumerable ingenious operations involving the application of flap and pedicle grafts, all groping toward some solution of this problem, but there was no definite plan of procedure. Hagner pointed the way. In 1931 I expressed the opinion that all types of free grafts, whether heteroplastic or autoplastic, were contraindicated, and that curative operations in the future would depend upon "the principle that the flaps should be of broad base, that they should be constructed from the penis itself and that the roof of the canal should be left entirely attached along the surface of the penis." Reports published since then, notably on the use of the Ombredanne operation by Lyle and the discussion of the Ombredanne, Bucknall and Thiersch procedures by Cabot, Walters and Counseller, all give support to these principles of curing hypospadias. Today I would like to deal quite specifically with the cure of these conditions.

HYPOSPADIAS

I shall first consider hypospadias and the correction of the deformity other than the urethroplasty. It is my belief that no operation should be done for minor degrees of glandular hypospadias unless associated with this urethral defect there is such a degree of deformity in the way of downward curvature of the penis that this deformity must be corrected, and in doing so one is necessarily driven to the consideration of the reconstruction of the urethra. In other words, there are cases of hypospadias in which the external urethral meatus may be in only a slightly abnormal position, but in which the downward curvature is so marked as to require operation for its correction, and thus necessitates a urethroplastic operation. These are the only types of minor degrees of hypospadias that I feel should be subjected to operation. In one case of this type, where there was scarcely any hypospadias, the shortening of the corpus spongiosum resulting in a ventral curvature of the penis was so marked as to render the penis useless as a sexual organ. In this case it seemed to me necessary to divide the urethra and dissect out the corpus spongiosum, maintaining the glandular portion of the urethra which presented only the most minor degree of hypospadias. The hooded foreskin unfortunately had been removed and a urethral fistula had been produced in a futile attempt to lengthen the penis. I have not found it difficult to make a double anastomosis; that is to say, an intervening Thiersch graft between the glandular urethra and the proximal end of the penile urethra, providing there is no passage of urine whatsoever into the newly formed urethra, and, furthermore, providing there is no extravasation of blood, which I shall presently point out may be as damaging as the forcing of urine through the newly formed canal.

In my previous observations I pointed out that the earliest students of hypospadias determined that the deformity was not only due to the hindering bands on the ventral surface of the penis and the fibrous corpus spongiosum, but if the patient had reached any considerable age there was an atrophy of the blood spaces on the ventral surface of the corpora, and that, even though the hindering bands associated with the shortened Buck's fascia and the shortened corpus spongiosum were freely divided, the penis still tended to maintain a certain degree of deformity, and that on account of

this the correction of the deformity should be carried out very early in life, as soon as the child's nourishment had been established, approximately around the age of two. While I am still convinced that this is the age of election, it is by no means the age at which most of these patients will present themselves for the correcting operation. Some of them will be adults and many of them boys approaching manhood, and, while I am sure a better result is obtained by early correction, I am also quite sure that a fairly satisfactory result can be obtained even though one is compelled to operate on these patients much later in life.

The downward curvature of the glans, which is so often spoken of as uncorrectible, many times becomes corrected providing there is a free dissecting out of the corpus spongiosum. A tourniquet is first applied which makes the whole operation enormously easier. A transverse incision is made just anterior to the urethral orifice and the fibrous corpus spongiosum is dissected out between the cavernous bodies (Fig. 5), being careful not to go too far back with the dissection, because it will run into more normal tissue farther back and will leave the urethra projecting from a blunted corpus spongiosum. Having dissected out this band, the penis is then bent back over the hand and the ventral surface palpated for hindering bands, which are freely divided wherever they happen to be, dividing Buck's fascia down to the tunica albuginea of the cavernous bodies, but never cutting into the cavernous bodies on account of hemorrhage. The penis being freed in this manner, sutures are then laid to bring Buck's fascia together to control bleeding. All bleeding is controlled with the tourniquet removed before the skin is sutured. The most likely point to offer difficulty is the proximal portion of the corpus spongiosum. The skin is now sutured in the Heineke-Mikulicz method.

For the correction of the deformity I have not found it necessary nor advisable to transplant the foreskin to the ventral surface of the penis as suggested by Cabot and Edmunds, and previously by Beck. I am very much opposed to any diversion of the urinary stream for the accomplishment of this operation as this is unnecessary and is liable to result in pyelonephritis.

Assuming that the deformity has been successfully corrected, one now must give consideration to the formation of the urethra and naturally one must choose the type of operation that is likely

to be successful. At present there would seem to be three successful types of operation: the Thiersch operation, the Bucknall operation, and the Ombredanne operation. These three operations are more or less standardized so that one has in mind what one is contemplating doing. They differ from the more or less unstandardized procedures that have been recommended by general plastic surgeons. The Ombredanne operation and the Bucknall operation, as Cabot has pointed out, have yet to prove that the growth of hair in the urethra in subsequent years will not hazard the procedures as to make them inadvisable. Several years ago Churchman reported one case of the cure of hypospadias by Bucknall's procedure, but years later this same patient was operated on by Vermotten for the removal of a stone from the urethra which had formed upon hair growing in the urethra. Cabot has had a similar experience. I do not know of the experiences of Ombredanne in this regard. He has done a very large number of cases. Lyle states that it is easy to dissect out these hairs after the first stage of the Ombredanne procedure and that it does no harm to cut out a considerable portion of the skin lining the urethra. The great advantage of the Ombredanne operation is that it does not require diversion of the urinary stream and that sinuses do not often occur. Both the Ombredanne and Bucknall operations give bunglesome results in comparison with the Thiersch operation. The classical Ombredanne operation, of course, is ruled out if the child has been circumcised, which is many times the case, and Bucknall's operation is not applicable in cases of perineal hypospadias. I have modified Bucknall's operation so that a urethral tube formed from the penis is attached to the scrotum buried between lateral flaps which are raised from a mid-line scrotal incision thus obviating the growth of hair within the urethra. One should have at his command, therefore, a thorough working knowledge of all three of these operations, and a review of the many ingenious flap operations that have been done will at times be useful.

The Thiersch operation gives beautiful results providing it is successful. It is applicable to all forms of hypospadias. I have never found it necessary to carry out any dilatation after this operation nor have I found the urinary stream in any way constricted. On the contrary it is considerably larger than normal, even though one may think a fairly small urethra has been recon-

structed, so I would suggest for the preservation of tissues and to avoid tension that the base of the urethra in the Thiersch operation be not greater than the transverse diameter of the urethra at the hypospadiac opening. The one drawback of the Thiersch operation undoubtedly is the tendency to the formation of sinuses and I believe that these are directly attributable to one of three causes: Staphylococcus infection along the urethral tube, outspoken hemorrhage or small blood extravasations or incomplete diversion of the urinary stream. By closer attention to detail, sinus formation can be avoided in most cases. This brings up the method of diversion of the urinary stream if one chooses to do the Thiersch procedure. If one is operating for perineal hypospadias the urethra should be constructed down to 1 cm. or less of the perineal outlet at one operation and then a suprapubic drainage done for closure of the perineal outlet. The tissues in this region, being quite thick, heal readily, and perineal sinuses, I believe, are extremely uncommon. In a sense, therefore, perineal hypospadias offers fewer, if any more, difficulties than penile hypospadias. Assuming then that we have set out to correct penile or penoscrotal hypospadias by the Thiersch method, it is my custom to do a suprapubic drainage one week before the urethroplasty is contemplated. At the end of one week one takes up the urethroplasty. A slightly curved sound is passed down to the perineum and a silkworm suture is thrown around this with a curved needle. Cabot has expressed his belief that he does not consider this suture advisable, but in this regard I differ with him. The suture does not cause stricture and it tends toward occluding the urethra, which is most important. The external urethrotomy then is performed with meticulous attention toward the stasis of blood, for in one of my cases on the eighth day following an erection a small artery forced blood up through the urethra from the perineum and caused an extravasation around the new urethra which threatened the entire urethroplasty and resulted in a small sinus. The perineal and suprapubic tubes are both connected with sterile bottles and every effort is made to maintain a sterile system to prevent infection of the urinary tract according to the plan of Bumpus.

I shall not go into details of performing the urethroplasty other than to state certain features of technic that may be of value. Iodine-alcohol preparation is used. The utmost care as to surgical

technic should be maintained. Absolute stasis of blood must be obtained. The outer skin flap should be dissected around the penis until there is very little if any tension. For inner sutures I have found No. 000 plain catgut on a No. 8 semicurved cutting needle satisfactory. For the superficial sutures I have used black silk on straight intestinal needles. At the completion of the operation the penis will have a rotated appearance, but this should give no concern as it will ultimately straighten out. As to dressings, I have used very few—usually a piece of gauze around the penis held in place by adhesive tape without much tension. It is not changed for about eight days providing everything looks all right, as the slight amount of blood that will exude through the flaps will stick the gauze to the flaps, and tinkering with the wound I believe to be harmful. I am doubtful as to the value of any dressings.

In my opinion these patients must have continuous nursing to see that the drainage tubes are properly draining at all times. I am doubtful as to whether anyone should undertake the cure of any child in which it is impossible in one way or another to procure continuous day and night nursing. Without it one will only meet with grief and an almost sure failure of the operation.

There should be no hurry about the child's bowels moving, as the patient should be kept quite quiet. I have found it advisable to have the covers down to the penis and up to the penis with the whole region constantly exposed so that one can see what is going on. Usually the question of erection is dismissed with the admonition to give large doses of bromides. Erections, while they occur of course in childhood, do not seem to be so bothersome if the child is operated on somewhere before the age of puberty. The age of choice I should say would be somewhere under nine years of age, but again that is not often within our choosing. I am very doubtful as to whether in older boys bromides have any value and this matter of combating erection is something that we have still to work out for the successful cure of these patients.

In about two weeks the suprapubic drainage tube will probably come out. The same may happen to the perineal tube. If the perineal tube comes out at this time, I would suggest that it be left out, but the suprapubic one should be replaced by one that is easily put in and taken out and easily held in place, and for this purpose

I devised my suprapubic disk drainage tube. The urinary stream should be diverted for about five weeks following the urethroplasty before removing the suprapubic drainage tube.

EPISPADIAS

During the last several years surgeons have gradually perfected a technic for uretero-intestinal anastomosis, and I have no doubt that this operation has certain fields of usefulness, but epispadias with incontinence is not one of them. Uretero-intestinal anastomosis is never curative of anything, and certainly should not be lightly applied to any type of urinary deformity in childhood.

Epispadias without incontinence presents no particular difficulties and I believe it is more easily cured than the average case of hypospadias. It is not generally known that as far back as 1880 Duplay pointed out that it was his belief that incontinence in epispadias was due to a defect in the constrictor muscle at the neck of the bladder and that this could be cured by operation. Cases of incontinence in epispadias were cured very early by bringing together the tissues at the neck of the bladder and the urethra. For these observations we are tremendously indebted to Thiersch, Cantwell, Page, Bouffin, Trendelenburg, and Young. The success of the operation depends upon fairly extensive freeing of the vesical neck beneath the symphyseal band and by the rather tight reconstruction of the vesicle sphincter in this region. When the urethroplasty is attempted, the sutures that are laid beneath the symphyseal band and along the corpora cavernosa may have a tendency to shut off the blood supply of the corpora and of the glans penis so that these must be watched most carefully. I shall show you today a case of a boy suffering with a very marked degree of epispadias with incontinence who now has perfect urinary control, perfect ability to empty his bladder and whose urine is entirely normal.

NOTE: This paper was illustrated by motion pictures.

DISCUSSION

DR. FRANCIS R. HAGNER (Washington, D. C.): I want to congratulate Dr. Cecil on his results with these patients. He has had a number of them, probably more than anybody else in this country, and his results have been really remarkable. We have all had failures and we have all had some successes.

The familial history in some of these cases is interesting. I saw two patients in Kentucky who were members of a family of five children. All five of these patients had complete or perineal hypospadias. They had not been operated on. Two of them were living as men and three were living as women. The three who were living as women didn't wish anything done and wanted to continue to live thus.

The circular graft that I reported to the society some few years ago for straightening the penis is, I believe, a valuable thing. Of course, in young children I do not usually operate until they are about five or six years old. It is best to let the penis get somewhat larger. When the penis is very small the operation is not so satisfactory, but in young children, say children five or six years of age, we certainly have had excellent results following the use of the circular graft for straightening the penis. This operation is done a number of years before the plastic work is done.

Dr. Cecil spoke of the twisting of the penis following the sewing of the graft. We have followed the rule of making two incisions on the dorsum of the penis, leaving them open. This procedure takes the tension off the graft and rather tends to prevent the twisting of the penis that is shown in the pictures.

DR. EDWARD L. KEYES (New York City): I can certify to an experience with four cases in which I have employed Dr. Hagner's graft. It is very useful. It is the only operation that permits us to overcome the contraction of the lower part of the corpus cavernosum to which Dr. Cecil has alluded, putting the graft right into the sheath and the lower part of the corpus cavernosum. There is no hemorrhage. There are no complications. The graft, however, like any other plastic procedure, may be employed quite unintelligently. I have recently seen two patients in our clinic on

whom it has been applied. On one of them it had done its trick and on the other one it had simply made a knot in the skin of the lower part of the penis, which must be removed.

I should agree with Dr. Hagner that most of us are such bad plastic surgeons that the longer we wait to do even this little straightening operation the more likely we are to succeed. I should feel that for the reconstruction of the urethra one should wait until the patient has reached an age where at least a good deal of genital hair has grown, that the operation should be performed without shaving of those regions that are to be employed in the plastic operation, and that, as Dr. Blair has suggested, the growth of hair be overcome not by electrolysis, not by x-ray, but by excision of each individual hair follicle. I quote Dr. Blair because I have recently seen him operate and reconstruct a urethra and have been delighted to see the work which he could do. I doubt if anyone here, possibly with the exception of Dr. Cecil, could do the plastic work in which, of course, he is peculiarly expert. I was particularly struck with the fact that if there is a prepuce spared him that some other surgeon hasn't taken away, Dr. Blair uses this to form a new balanic urethra which gives the nozzle that Dr. Cecil's patients so conspicuously lack and that the patients of most of us so conspicuously lack.

KAPOSI'S DISEASE OF THE PENIS

REPORT OF TWO CASES

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Kaposi's disease or, as he originally named it, "idiopathic multiple pigment sarcoma of the skin" is a fairly rare disease.

Adair and Trombley have analyzed seventeen cases seen and treated at the Memorial Hospital. These are exclusive of the two cases of Kaposi's disease of the penis. I am indebted to their analysis of these seventeen cases for a summary of the symptoms and treatment.

Kaposi's original article summed up the symptoms of the disease as follows:

> "With no known general or local cause, nodules as large as pigeon shot, peas or hazel nuts, and of a bluish or brownish red color begin to develop in the skin. Their surface is smooth; their consistence firm and elastic. Sometimes they are expansile, like erectile tumors. They are isolated and when increased in size appear as globular prominences, or they form groups and remain somewhat flattened. In the latter cases the central nodules of the plaque undergo involution and give rise to a dark pigmented depression. They always occur first on the sole and dorsum of the foot and soon afterwards on the hands and are associated with a diffuse thickening of the skin and deformity of the hands and feet. The lymphatic glands do not become involved with the disease. Finally similar nodules begin developing in the mucous membrane of the larynx, trachea, stomach, intestines and liver, but most abundantly throughout the large intestine as far as the anus. The disease always terminates fatally within two or three years."

Some of Kaposi's original ideas have had to be modified. For instance, the average duration is five to ten years, while some have survived twenty-five years. Occasionally there has been spontaneous recovery.

In the seventeen cases reported by Adair and Trombley, the ages of the patients are from twenty-one to eighty. Nine cases occurred between fifty and sixty-five years. There were fifteen men and two women.

The authors go into the etiology at some length. Bacteria had

been held to be a cause but this was not proven. Because of the severe pain which some patients suffer and which is the prominent element in one of our penis cases, a neurogenic origin has been suggested. There has been supposed to be some relation between Kaposi's sarcoma and mycosis fungoides. The two diseases have occasionally occurred together in the same patient.

Adair and Trombley have not succeeded in growing any bacterial or fungus colonies from their cases.

The histories on their series of cases shows that a large percentage of the patients had occupations which necessitated much walking and standing.

TREATMENT

No treatment apparently had any effect upon the disease until x-ray treatment was instituted. Apparently low voltage x-ray treatment can keep the disease more or less indefinitely in check and causes the skin nodules at least to disappear temporarily. Some of the Adair and Trombley patients were treated with the low voltage machine (140 kv.), usually used at 10 to 15 cm. and filtered with aluminum. The doses varied from 500 to 800 R over each area; only one treatment being given to each area in each course.

In the seventeen cases of Adair and Trombley, six patients have died since first being seen; four died of the disease seven years, four and one-half years, eight months, one year and nine months, after receiving treatment. Two patients had no follow-up. Eight patients are alive, one to fifteen years, with a lesion still present; six, with no evidence of disease, three and one-half years to six months after treatment. In one patient now being treated, tumors have shown marked regression from the radiation but have not entirely disappeared.

The report of the two cases of Kaposi's disease of the penis are as follows:

Case 1.—F. W. W., aged forty-five, was admitted to the Memorial Hospital, December 18, 1934, with the following history: For the past several months the patient had noticed several lumps on the head of the penis progressively growing larger, no ulceration, no previous venereal history. The nodules were excessively tender and erection was very painful. He was in excellent general health otherwise.

Physical examination revealed two submucous nodules on the penile

head; one 1.5 cm. in diameter and the other 1 cm.; purplish blue in color, not hard, exquisitely tender. At the base of the penis there was a small indurated area in the corpus cavernosum. Glands of the groin were normal. The lesion was unlike any I had ever seen in this region. The patient was also seen by Dr. Ewing, who suggested that it might be blastomycoses. After consultation it was decided to remove the upper nodule under novocain for pathologic examination.

Pathologic examination was as follows: Melanoma was possible, but I rather favored the type of Kaposi's sarcoma. The tumor had features which would tend to confirm a neuro origin of Kaposi's disease. On this diagnosis a partial penectomy was done 1 cm. beyond the tumor area and a small section from the corpus cavernosum. The wound healed without trouble.

X-ray treatment given to the penis; 300 roentgen, target skin distance 30 cm. and 1 mm. of aluminum filter.

Up to the present time, six months following treatment, there has been no sign of any recurrence.

Case 2.—R. LaF., aged fifty-six, an Italian solderer, married, was referred to the hospital, March 3, 1934, by his family physician for treatment of a cancer of the penis. The man had always been well except for pleurisy ten years before. In January, 1934, two months previously, he noticed a small growth on the glans penis. It was red and felt solid. Growth was rapid. It was never painful or tender. Ulceration never appeared. No discharge from the urethra or from beneath the prepuce was noticed. In general the patient was healthy. The penis looked normal when the prepuce was not retracted. When the glans was exposed a round, solid appearing, cherry red growth was seen, located on the dorsum, to the left of the midline, and immediately proximal to the corona glandis. The lesion was 1 cm. in diameter. Its surface was glistening and smooth, but with rounded irregularities. The base was as broad as the greatest diameter. The growth felt firm but not hard. No induration was present at the base. Beneath the tumor and apparently connected with it there was marked induration in the cavernous tissue of the glans. This extended proximally in the shaft of the penis for 3 cm. There was no inguinal adenopathy.

The picture was that of a cancer of the glans penis with considerable lymphatic extension. However, several factors seemed unusual:

(a) The setting which we associate with a penis cancer was not present. While the prepuce was long it was quite loose. There was no evidence of retained secretions nor of chronic irritation of the glans or prepuce.

(b) The lesion was deep red while penis cancers are pink.

(c) There was no ulceration nor slough.

(d) Although there could be little doubt of the connection between

the primary tumor and the induration in the shaft, the extension seemed too great for a tumor of two months' duration and 1 cm. in diameter, especially when the tumor was papillary and showed no induration immediately at the base.

(e) Absence of inguinal adenopathy with such an advanced tumor was unusual. For these reasons we thought that we were dealing with some disease other than cancer, the true nature of which was not known.

Therefore, conservative treatment was adopted. An unsuccessful attempt was made to aspirate the induration of the corpus cavernosum, but no biopsy was performed on the primary growth. Instead, it was entirely removed with one sweep of the electric cutting loop. Coagulation stopped the bleeding. With the scalpel an incision was made down to the indurated area of the shaft and a piece was removed. This tissue looked white and comparatively avascular.

Histologic examination of the primary tumor revealed "Kaposi's hemorrhagic sarcoma," while the deeper, dense tissue showed merely hyaline changes in connective tissue.

The patient made a rapid recovery and has shown no evidence of recurrence in fourteen months.

DISCUSSION

DR. ROGER C. GRAVES (Boston, Mass.): Dr. Barringer has described a very interesting condition and one that we will have to include in the differential diagnosis of neoplastic diseases of the penis. I have had occasion to see many cases of carcinoma and one case of sarcoma, but I never have seen one of these Kaposi tumors.

I found upon inquiring just before leaving home that at Pondville, our Massachusetts State Hospital for cancer, among almost 10,000 cases there has been just one of Kaposi's disease. In this instance, an arm was involved. The lesion is so rare that I thought you might be interested to see photographs of that one case, even though the lesion did not occur in the genital organs.

The patient was an Italian laborer, sixty-two years old. He had lived in Italy until he was twenty, which possibly gave him an opportunity to accumulate the infection that later led to his downfall, because I believe there has been a theory advanced, either by Kaposi originally or later by Ewing, that this hemorrhagic sarcoma of the skin may have its base in some sort of infectious granuloma. He had been in another hospital before coming to Pondville and various examinations had been made without a positive diagnosis. When he came to our hospital there was a mass in the axilla and metastases were found in the right lung and pleura. He died soon after admission. (Slides.)

CONGENITAL CANALS AND CYSTS OF THE GENITO-PERINEAL RAPHE

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From the Department of Urology, University of Virginia

My interest in this topic was aroused by observations in six patients, four of whom oddly enough have been seen since January of this year. The first patient in the series found me quite unaware of the histologic and etiologic implications of the presenting condition, though the surgical problem was one of the utmost simplicity. A search made then for some pertinent literature, and supplemented latterly for the period since 1916, revealed scant reference to the subject in textbooks and journals published in English. Articles in other languages were fairly numerous. The study suggested that canals and cysts of the raphe are rather uncommon. This relative rarity, in conjunction with certain clinical and etiologic features, possibly justifies a brief review of my cases and their correlation with reports of other writers.

The case group for presentation consists of three raphal canals and three cysts, two of the latter being in the penile raphe, the third peri-urethral. The six readily permit joint discussion since, as will appear later, they seemingly share a common origin in the same type or types of imperfections in the development of the external genitalia and urethra.

CASE REPORTS

Case 1.—A white boy, aged thirteen, had first noted a small, reddish, tender nodule in the penile raphe, about 2 cm. from the end of the prepuce, one year prior to admission on June 21, 1931. Five or six days before admission linear redness and swelling spread rapidly backward along the raphe of the penis, scrotum and perineum from the site of the original nodule and finally stopped 1 cm. short of the anus. Multiple pustules developed in both extremities of the process.

Upon examination the cord of induration obviously involved the skin except in the posterior part of its course through the scrotum, where, while adhering closely to the midline, it was palpably below the skin level. Pus could be expressed from the penile and perineal openings. In its stage of maximum suppuration, a few days after admission to the ward, the tract would admit a probe from one end

to the other. Since suppuration developed first in the anterior half and later in the posterior half, the tract was incised in two stages. The condition at its height is well illustrated in Figure 1. This drawing was made from diagrams sketched to scale at the time of operations. A small piece of the wall removed for histologic study showed only granulation tissue. Culture from the canal obtained Staphylo-

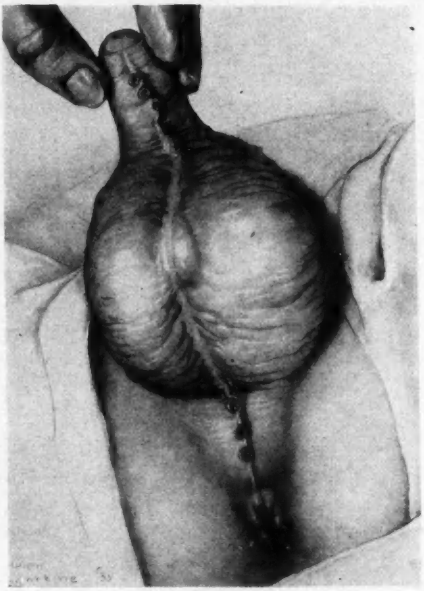

Fig. 1. Case 1. Drawing from sketches made to scale at time of operations. The superficial portion of the raphal canal is well illustrated. In the posterior part of the scrotum the canal dips below the skin surface to reappear in the perineal raphe.

coccus aureus. The voided urine was pus-free. Healing was prompt after incision of the tract throughout its length.

Case 2.—A white man, aged twenty-four, was admitted to the hospital January 10, 1935. In December, 1932, he noted soreness in the midline undersurface of the penis and six "water blisters" developed here in series. Each became tender and soon ruptured, leaving six small openings. In the spring of 1933 he contracted a gonorrheal urethritis, and was discharged as well eight weeks later. Except for

some mild inflammation now and then, the raphal openings gave no serious inconvenience until December, 1934. At that time swelling developed about each orifice coincident with the appearance of a mucopurulent discharge therefrom. Two weeks prior to admission the most posterior opening apparently became occluded. This occlusion was followed by a localized, tender swelling which persisted.

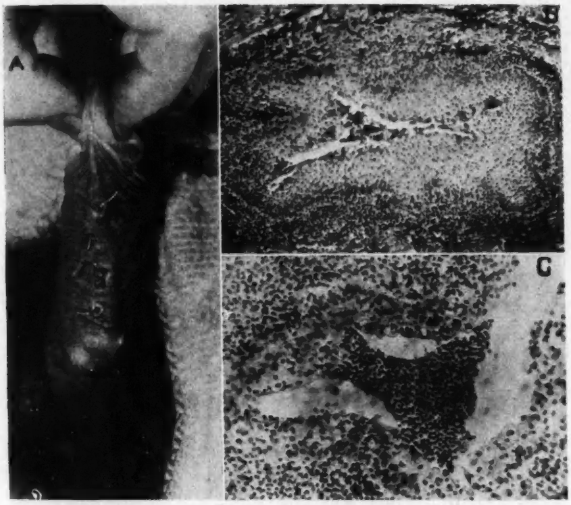

Fig. 2. Case 2. *A*, Five openings along the raphe are shown with the posterior end of the canal in an abscess phase. The probes in position suggest a series of canals, but serial sections indicate a continuous channel of varying caliber. *B*, Stratified squamous epithelium lining the canal anteriorly. *C*, Transitional epithelium lining the canal posteriorly.

The presenting picture is shown in Figure 2*A*. There was a superficial indurated cord in or just beneath the penile raphe from the most anterior opening to the posterior abscess. Fine probes demonstrated channels between openings one and two and between openings three, four and five, but a continuous canal throughout the length of the palpable cord could not be demonstrated by this maneuver. Gonococci were found by smear and culture from the canals and the abscess. The voided urine and prostatic secretion were quite normal. The skin carrying the canals and abscess was removed by a narrow elliptical incision. Prompt healing by first intention followed.

Pathologic report: An accessory canal in the median raphe of the penis showed chronic infection throughout its course and acute in-

fection in the posterior portion with abscess formation in the adjacent connective tissue. The lining of the anterior portion of the canal was typical stratified squamous epithelium, while posteriorly the lining had the appearance of transitional epithelium (Fig. 2, *B* and *C*).

Case 3.—A white man, aged twenty-six, was seen April 4, 1935. Four weeks after unprotected coitus, a "pimple" appeared in the frenulum shortly below the external meatus and from this a drop of pus would exude intermittently. There was no urethral discharge, no antecedent history of urethritis. Thumping pain and a marked increase in local tenderness developed in the region forty-eight hours before admission. The patient was referred with a diagnosis of penile chancre.

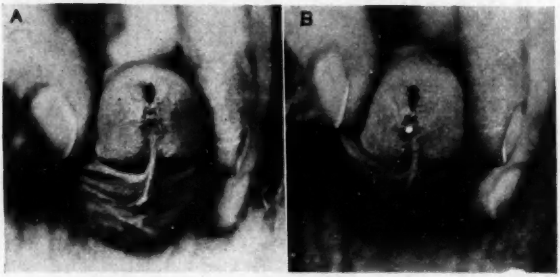

Fig. 3. Case 3. *A*, Note the roughened area below the meatus. It had been mistaken for a chancre. *B*, Drop of pus expressed from a blindly ending canal which extends to a depth of 12 mm. between the urethra and the frenulum.

Local examination revealed a rounded, tender area of induration immediately subjacent to the frenulum. Pressure thereon expressed a drop of pus from a minute opening in the center of the "chancre." Stains of this pus demonstrated many gonococci. The tract admitted the finest filiform, exactly in the midline, to a depth of 12 mm., about to the level of the corona. The patient's urine was pus-free. Advice to have the tract either incised or excised was refused. The local appearance is illustrated in Figure 3.

Case 4.—A man, forty-three years old, was admitted to the hospital for renal colic January 31, 1935. In his routine physical examination, a rather pedunculated cyst about 1 cm. in diameter was found arising in the penile raphe just anterior to the scrotum (Fig. 4). At no point was the cyst adherent to the overlying skin. A few millimeters adjacent there was a much smaller cyst, also in the raphe. The patient had first noticed the larger cyst seven or eight years previously and it had persisted unchanged without any symptoms. The cysts with the over-

lying skin were removed under local anesthesia. The larger cyst was filled with a brownish, mucoid material of smooth consistency.

Pathologic report: The larger cyst was lined by stratified columnar epithelium, composed of from five to ten layers of cells in different areas. Occasional large goblet cells lay embedded in the epithelium of the cyst wall. The lining of the small cyst was composed of from two to four layers of transitional epithelium. No goblet cells were found in the latter (Fig. 4, *B* and *C*).

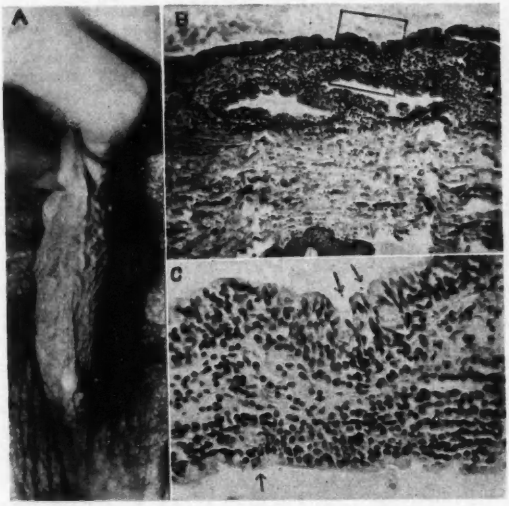

Fig. 4. Case 4. *A*, Small semi-pedunculated cyst of the penile raphe. *B*, Stratified columnar epithelium lining cyst. *C*, High power field from *B* to show goblet cells embedded in columnar epithelium.

Case 5.—This patient, twenty-eight years old, white, had noticed some difficulty in voiding ten days before admission, November 5, 1933. Definite straining was required to start and to continue the flow of urine. A few days later he found a tender swelling just back of the scrotum in the midline. For the next week he felt generally out of sorts and the difficulty in voiding steadily increased. There was no history of local trauma, urinary tract infection, or of any similar difficulty in the past.

In the midline of the perineum, just about the scrotoperineal angle, there was a localized prominence feeling to be about the size of an English walnut, definitely fluctuant, moderately tender. The urine

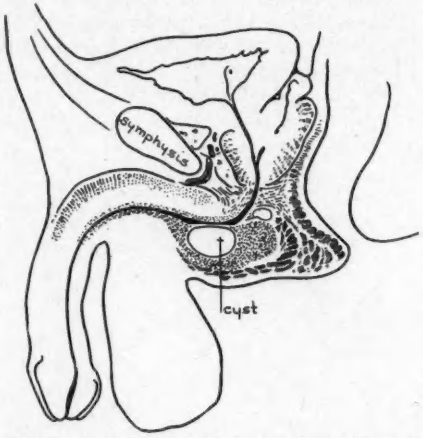

Fig. 5. Case 5. Diagram illustrating approximate position and size of peri-urethral cyst.

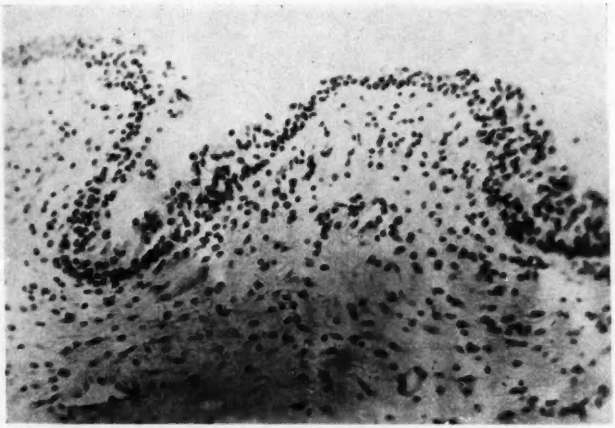

Fig. 6. Case 5. Transitional epithelium lining peri-urethral cyst.

was negative, temperature 99° by mouth. Diagnosis of an atypical peri-urethral abscess was made, though it was difficult to explain the origin of such an abscess in view of the history.

At operation the mass proved to be a cyst in the anterior portion of the bulb (Fig. 5). It contained about 20 c.c. of mucoid, chocolate colored fluid. In its dissection the urethra was inadvertently entered. A layer closure was made and healing was uneventful.

Pathologic report: The cyst was lined by quite characteristic transitional epithelium, composed in some places of eight to ten layers of small polygonal cells, in others of only two layers (Fig. 6).

Case 6.—A white man, aged sixty-eight, was seen in the out-patient department, May 13, 1935. A cyst about 1 cm. in diameter was found

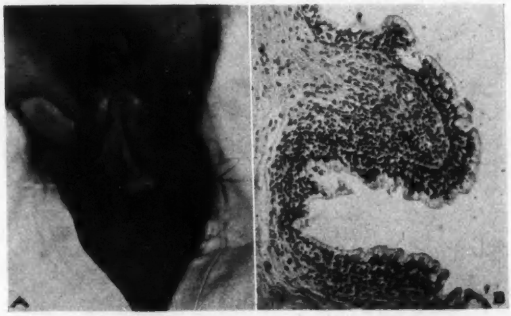

Fig. 7. Case 6. *A*, Small cyst, freely movable beneath the skin, at the posterior end of the frenulum. *B*, Cyst lining of high columnar cells overlying stratified columnar epithelium.

at the posterior extremity of the frenulum and at the border of the penile raphe (Fig. 7). The cyst had no deep attachment, and was freely movable under the skin. It had been present without change in size since the patient's boyhood and had never caused him any inconvenience. It was removed through a small nick in the overlying skin. The cyst was filled with a slightly cloudy, mucoid material.

Pathologic report: The cyst was lined by high columnar cells, similar to those seen in cervical glands, overlying stratified columnar epithelium. The picture was almost identical with that seen in cervical glands in cases of chronic cervicitis where there has been hyperplasia of the lining epithelium. Only a few desquamated cells and coagulated fluid were seen in the cyst cavity (Fig. 7, *B*).

ETIOLOGY

There is general agreement among writers upon the subject that both canals and cysts of the raphe are congenital in that they correspond to defects in the embryologic development of the external genitalia. Two explanations of their origin have been offered: (1) They arise from epithelial rests incident to incomplete closure

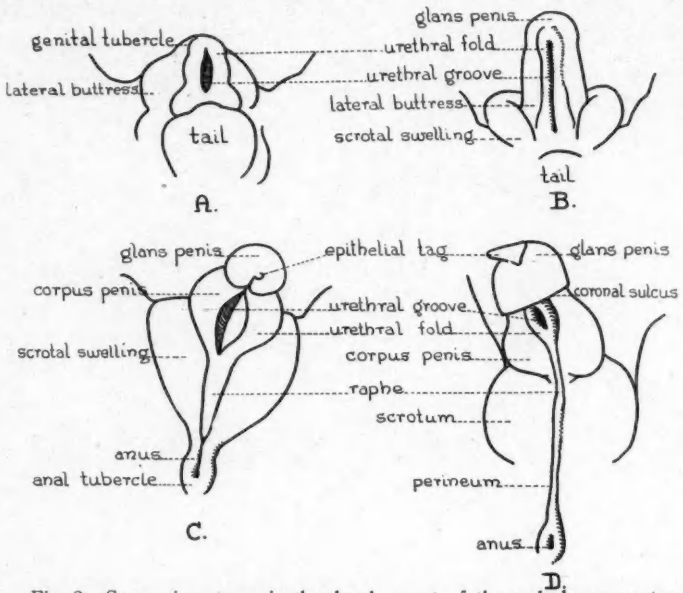

Fig. 8. Successive stages in the development of the male human external genitalia. *A*, Genital tubercle period, 14 mm. embryo. *B*, Phallus period, 21 mm. embryo. *C*, Beginning of definitive period, 45 mm. embryo. *D*, Later stage of definitive period, 58.8 mm. embryo. (Redrawn from Jordan and Kindred after M. H. Spaulding.)

of the urethral or genital folds, and (2) they develop from split-off outgrowths of embryonic epithelium after primary closure of the folds.

One recalls that ventral or caudal midline fusion is involved in the formation of the perineum, scrotum and urethra and that this fusion leaves the genitoperineal raphe as a permanent surface marking of the coalesced perineal, genital and urethral folds (Fig.

8). The epithelium of the depth of the urethral groove on the under surface of the phallic projection from the genital tubercle seems in all probability to represent a prolongation from the lining of the urogenital sinus. The urethral mucosa thus has, except in its balanitic portion, an endodermal origin. The balanitic urethra develops from an epithelial plate which invades the primitive glans ventrally as a solid column of cells, later breaking down to form a groove with the eventual fusion of the groove margins inferiorly to furnish a canal continuous with that created by the more posterior fusion of the urethral folds.

It would seem reasonable to assume that in this coalescence of

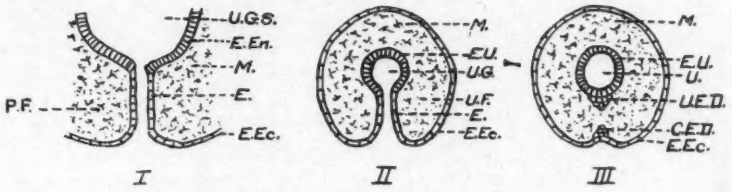

Fig. 9. Diagrams of the development of the perineum and the genital tubercle. I. Section perineal folds at level of urogenital sinus. II. Section genital tubercle, urethral groove and folds. III. Section genital tubercle at the moment of closure of the urethral folds.

Key: U.G.S.—Urogenital sinus. U.G.—Urethral groove. U.—Urethra. P.F.—Perineal folds. U.F.—Urethral folds. M.—Mesoderm. E.En.—Endodermic epithelium. E.Ec.—Ectodermic epithelium. E.U.—Urethral epithelium or modified ectodermic epithelium. E.—Epithelium lining internal face of folds. U.E.D.—Epithelial debris of mucous type from internal face of folds. C.E.D.—Epithelial debris of cutaneous type.

the urethral and genital folds some nests of epithelial cells might be enclosed in the plane of fusion. These rests could later appear as canals or cysts according as there was or was not an opening on the skin surface. The ultimate depth of the canal or cyst from the skin surface would depend upon the depth at which the epithelial inclusion occurred. The derivative structure would have an epithelial lining in harmony with the epithelium from which it arose, that is to say, endodermal or columnar if from cells of the primitive urethra, ectodermal or squamous if from cell rests at or near the skin level (Figs. 9 and 10). The process would be quite comparable to the origin of branchial cleft cysts. The analogy would also hold for the type of lining cells found in the latter,

since these are columnar or stratified squamous according as the cysts have arisen from the deeper or more superficial portions of the cleft.

The above views express the commonly accepted theoretic explanation for congenital cysts and canals of the raphe. The second etiologic interpretation assumes a migration of embryonic epithelium from either the urethral endoderm or the surface ectoderm along the line of fusion. Such outgrowths could give rise to either

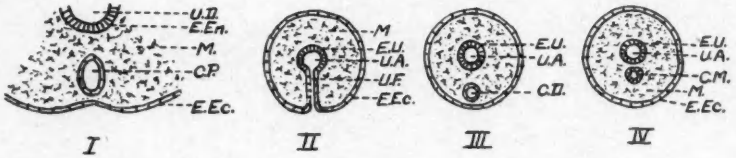

Fig. 10. Diagrams of the modes of formation of the principal anomalies of the perineum and genital tubercle. I. Formation of dermoid cyst of the perineal raphe. II. Formation of a congenital penile urethral fistula. III. Formation of dermoid cysts of the penis and some urethral duplications. IV. Formation of mucous cysts of the penis and of congenital urethral diverticula.

Key: U.D.—Deep urethra. U.A.—Anterior urethra. U.F.—Urethral fistula. C.P.—Dermoid cyst perineal raphe. C.D.—Dermoid cyst of penis or double urethra. C.M.—Mucous cysts or diverticulum. E.Ec.—Cutaneous ectodermic epithelium from which dermoid cysts arise. E.U.—Urethral epithelium from which mucous cysts arise. (After Mermet, *Revue de Chirurgie*, 1895.)

cysts or canals and, if near the urethra, to diverticula. Johnson has adduced factual evidence of such an occurrence by his most instructive observations in an embryo of 88 mm. and has made a detailed description of this embryo in several articles. He found cellular outgrowths from the penile urethra, some completely split off, some in the process of being separated, and both types already canalized. He interpreted his findings to afford very definite evidence of the probable origin of some periurethral cysts and some diverticula.

CLINICAL COMMENT

Congenital cysts of the raphe are classified as mucous or dermoid according as the lining epithelium is columnar or stratified squamous. For those with a squamous lining, epidermoid would seem to me a more apt term than dermoid unless the cyst wall contains hair follicles, sebaceous or sweat glands, and I have not

found the presence of these structures described. As one would expect, the epidermoid cysts are very much more frequent than the mucous type. Mermet collected twenty-three cases of raphal cysts. Sixteen of these were epidermoid, four were mucous. Ottow, after encountering two raphal cysts in soldiers during the World War, examined five hundred nursing male infants for similar anomalies and so discovered three small cysts in the region of the frenulum, all three proving to have an epidermoid lining. It is noteworthy that both the raphal cysts I have encountered were of the mucous type.

These cysts may be located anywhere along the raphe from the preputial orifice to the anus. Even though standard urologic textbooks give scant attention to cysts of the external genitalia, their predilection for the raphe is mentioned fairly often. Objection may well be raised to the inclusion of the peri-urethral cyst of Case 5 in a discussion of canals and cysts of the skin raphe. I feel that the etiology of the former is so probably the same as that of the latter that its inclusion is justifiable. While I have found no report of what might be called congenital septal cysts, that is, those which are neither exactly peri-urethral nor subcutaneous, as might occur in scrotum, for example, I have no doubt that such do exist. I have seen one patient who, I thought, had a cyst of this location, but surgical attention was refused so I have no corroboration of my diagnosis.

These cysts cause the patient little or no inconvenience unless they become infected or unless, from their location and size, they interfere with coitus. Infection apparently is quite rare. Hajós reports a cyst of the prepuce equal in size to that of the glans without any resulting sexual inconvenience.

Canals of the raphe are almost invariably lined by stratified squamous epithelium. Occasional reference is made in the literature to the fact that the canals may have a columnar lining, but evidently this is quite rare. Gourgerot had histologic studies in nine of his eleven cases; all showed stratified squamous epithelium. The same was true in nine similar canals reported by Okawa. The lining may be more or less completely destroyed by infection. In our first case only granulation tissue was shown in the one small section removed for study. At the time, however, I was not alive

to the anatomic basis for the presenting picture and quite possibly at least some fragment of a lining epithelium would have been shown had a sizable portion of the canal been promptly excised when the patient was first seen and before frank suppuration had become so extensive.

It is difficult to estimate with what frequency canals of the raphe occur. Gougerot refers to the thesis of one of his pupils, Papa, who, in 1933, had been able to collect only thirty-two instances from the literature. On the other hand, Gougerot himself observed eleven cases in a few months. Okawa reported ten personal cases, in which two patients incidentally also had cysts of the raphe. Rupel in this country described eight cases in two papers. These are the largest series that I have found reported by one individual.

The canals may end blindly with only one orifice or may have two or more openings on the surface. They may be seen in series along the raphe but unconnected, and even two superimposed canals have been described. The canal may be very short or extend practically the whole length of the genitoperineal raphe, as was observed in my first case. In this instance the canal maintained midline continuity throughout its extent, but did dip definitely below the skin level for a considerable portion of its trajectory through the scrotum.

The canals apparently give no indication of their presence until they become infected, usually with the gonococcus. Attention is then directed to them by the local inflammatory changes. There are not infrequent reports of the canals being so infected, just as is true for accessory para-urethral canals or ducts, without infection incurring in the urethra itself. More often the infection of the urethra and canal is coincidental, and the latter continues to give trouble indefinitely until handled surgically. The persisting infection in the canal may serve as a source for re-infection of the urethra or for its first infection if it has originally escaped.

The diagnosis of an infected canal is naturally very easy if one is aware of the defect which predisposes to a localized linear inflammation in the raphe. Statements in the literature mention the mistaken diagnoses of chancre, chancroid, skin abscesses, lymphangitis. In my own series, the patient in Case 2 was referred for

dark field examination because of a diagnosis of chancre of the frenulum.

TREATMENT

Cysts of the raphe, whether on the skin surface or more deeply situated in the midline septum, obviously should be removed surgically if any treatment at all is given. In my small series, the peri-urethral cyst was causing definite urethral blockage and clearly required removal. The cysts on the skin surface were chance findings and, while the patients were glad to be rid of them, removal was primarily done to permit study of the cyst walls.

Canals of the raphe should be excised or incised according to the exigencies of the individual case. In the stage of frank suppuration, no doubt incision would be the method of choice; with inflammation more quiescent, excision can be expected to secure prompt healing.

SUMMARY

1. Six cases are reported: five with canals or cysts of the genito-perineal raphe, one with a peri-urethral cyst.

2. These canals and cysts are satisfactorily explained as arising from epithelial rests incident to imperfect ventral fusion in the formation of the external genitalia or from masses of epithelial cells which have migrated from the primitive epithelium. The cysts and canals, therefore, are congenital in origin.

3. The canals and cysts have an epidermoid or mucous lining depending upon their cells of origin. The lining of the canals is almost invariably epidermoid and the same is true for a smaller majority of the cysts.

4. The raphal canals apparently manifest themselves only after infection, usually with gonorrhea. The canals may become so infected without involvement of the urethra.

5. The treatment of both canals and cysts is surgical.

NOTE: I wish to acknowledge my indebtedness to Drs. J. R. Cash, H. E. Jordan and J. E. Kindred for generous assistance and advice concerning the pathologic, histologic and embryologic questions raised in the study of this case series.

REFERENCES

1. GINELLA, A.: Gonorrhea exclusively confined to accessory canaliculus of the penile raphe. Dermosifilographo, 3:34-39, 1928.
2. GOUGEROT, BURNIER et TISSOT: Gonorrhea of accessory suburethral canals. Ann. d. mal. ven., 28:641-659, 1933.
3. HAJOS, I.: Zylinderepithelzyste am Penis. Deutche med. Wchschr., 22:151, (Jan.) 1926.
4. JOHNSON, F. P.: The later development of the urethra in the male. Jour. Urol., 4:447-502, 1920.
5. JOHNSON, F. P.: Diverticula and cysts of the urethra. Jour. Urol., 10:295-310, 1923.
6. JORDAN and KINDRED: A textbook of embryology. New York: D. Appleton and Co., 1932.
7. MARION, G.: Traite durologie. Paris: Masson et Cie, 1921.
8. MERMET: Congenital cysts of the genito-perineal raphe. Revue de chirugie, 15:382-435, 1895.
9. MILIAN, G.: Gonorrheal abscess of the penile raphe. Bull. Soc. franc. de dermat. et syph., 33:469, 1926.
10. MCKAY, R. W.: Anomalous ducts of the pendulous urethra. Jour. Urol., 22:213-237, 1929.
11. OKAWA, S.: Chronic Gonorrheal inflammation of para-urethral ducts. Acta dermat., 14:229, 1929.
12. OTTOW, B.: Cysts of the preputial raphe. Ztschr. f. Urol. Chir., 30:51, 1930.
13. OUDARD and JEAN: Congenital accessory urethral canals. Jour. durol., 11: 177-201, 1921.
14. PRAKKEN, J. R.: Cysts of the penile raphe. Nederl. tijdschr. v. geneesk., 77:1784, 1933.
15. RUPEL, E.: Epidermal canals infected with gonorrhea. Surg., Gynec. and Obstet., 39:636-638, 1924.
16. RUPEL, E.: Epidermal canals of median raphe. Jour. Urol., 29:617-620, 1933.
17. SCHOENHOF, S.: Infection of accessory canals of penis and scrotum. Arch. f. Dermat. u. Syph., 153:132-144, 1927.
18. SPAULDING, M. H.: The development of the external genitalia in the human embryo. Contrib. Embryol., No. 61:69-88, 1921.
19. TEDESCHI, N.: Gonorrhea confined to canaliculus of penile raphe. Giov. ital. di dermat. e. sifil., 69:591-601, 1928.